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Editors
H. SANTAPAU, S.J., & HUMAYUN ABDULALI

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2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

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CONTENTS OF VOLUME 57, NO. 3

PAGE

A Visit to the Flamingos in the Great Rann of Kutch. By Shivrajkumar of Jasdan, R. M. Naik, Ph.D., and K. S. Lavkumar of Jasdan. (*With three plates*) 465

Ferns of Nainital. By D. S. Loyal and S. C. Verma (*With one map*) .. 479

Critical Notes on the Orchidaceae of Bombay State. IV. The genus *Dendrobium* Sw. By H. Santapau, S.J., F.N.I., and Z. Kapadia, Ph.D. (*With ten plates*) 491

Analysis of the Proteins of Egg-white as an aid to the Classification of Birds. By D. B. Peakall, M.Sc., Ph.D., M.B.O.U. (*With one text-figure*) .. 511

The Birds of Nepal. Part 2. By Biswamoy Biswas 516

Revision of Indian Spiders of the genus *Cyrtarachne* (Argiopidae : Arachnida). By B. K. Tikader. (*With five text-figures*) 547

Thysanoptera from the Nilgiri and Kodaikanal Hills (South India). By T. N. Ananthakrishnan. (*With six figures*) 557

A Systematic and Ecological account of the Cyanophyceae of Hoshiarpur By P. C. Vasishta (*With twelve figures*) 579

The Genus *Veronica* Linn. of Eastern India. By Narendra Mohan Dutta. (*With a plate*) 590

Report on the status of the Browantlered Deer of Manipur (India). By E. P. Gee, M.A., C.M.Z.S. (*With 3 plates and 3 maps*) 597

Some Notes on Sanctuaries and Wild Life in South India (1959). By O. H. de St. Croix 618

Obituaries :

S. P. Agharkar 635

C. H. Donald 636

Stanley Henry Prater (*With a plate*) 637

Reviews :

1. Born Free. By J. Adamson. (I.R.) 643
2. Common Malayan Birds. By M. W. F. Tweedie. (S.A.) 643
3. Bulletin of Entomology, No. 1. (Published by the Department of Zoology, Loyola College, Madras). (R.R.) 644
4. Butterflies of Formosa in Colour. By T. Shirozu. (T. Ikawa) .. 644
5. Common Malayan Butterflies. By R. Morrell. (R.R.) 645
6. Dragonflies. By P. S. Corbet, C. Longfield, and N. W. Moore. (R.R.) 646
7. Comparative Breeding Behaviour of four Species of North American Herons. By A. J. Meyerriecks. (J.H.C.) 648
8. The Lonely Tiger. By H. Allen. (D.J.P.) 649

MISCELLANEOUS NOTES :

1. Jungle Dogs kill Sambar doe. By G. V. R. Frend (p. 652). 2. How many young does a Chital have? By Editors (p. 653). 3. Indian Wild Boar (*Sus scrofa cristatus* Wagner) feeding on *Boerhavia diffusa* Linn. By R. S. Dharmakumarsinhji (p. 654). 4. Further Wild Life notes from Madhya Pradesh—A Rejoinder. By Editors (p. 655). 5. Colour aberration in the Whitecheeked Bulbul [*Pycnonotus leucogenys leucotis* (Gould)]. By Sálim Ali (p. 658). 6. Where do Leaf Warblers (*Phylloscopi*) sleep? By N. G. Pillai (p. 659). 7. A new race of Finn's Baya, *Ploceus megarhynchus* Hume. By Humayun Abdulali (p. 659). 8. The Blackbacked Woodpecker, *Chrysocolaptes festivus* (Boddaert), in Ganjam, Orissa. By K. M. Kirkpatrick (p. 662). 9. The Imperial Green Pigeon, *Muscadivora aenea* (Linnaeus), on salt-licks in Orissa. By K. M. Kirkpatrick (p. 662). 10. On the eggs of the Great Indian Bustard [*Choriotis nigriceps* (Vigors)] (*With a photograph*). By R. S. Dharmakumarsinhji (p. 663). 11. Association between different species of Turnicidae. By K. M. Kirkpatrick (p. 665). 12. Marsh Sandpipers (*Tringa stagnatalis*) colliding against telephone wires. By R. S. Dharmakumarsinhji (p. 666). 13. The Christmas Island Frigate-bird, *Fregata andrewsi* Mathews, in Indian waters—A correction. By Humayun Abdulali (p. 667). 14. Occurrence of the Least Frigate-bird [*Fregata ariel* (G. R. Gray)] in Bombay. By Humayun Abdulali (p. 668). 15. A note on the Common Monitor, *Varanus monitor* Linn. By P. L. Misra (p. 669). 16. Observations on the Red Earth Boa or Russell's Earth-snake [*Eryx conicus* (Schneider)]. By K. G. Adiyodi (p. 671). 17. Mating behaviour of the beetle *Hydrophilus olivaceus* Fabricius. By S. N. Mathur (p. 672). 18. Migrational flights of the Common Indian Crow butterfly [*Euploea core* (Cramer)]. By D. E. Reuben (p. 673). 19. *Plusia* (*Phytometra*) *ni* Hb. (Noctuidae) as a pest of Cabbage *Brassica oleracea* in south India. By B. Vasantharaj David (p. 679). 20. *Syngamia abruptalis* Walker (Pyralidae—Lepidoptera): A new pest of *Mentha viridis* L. in south India. By A. Abdul Kareem, S. Jayaraj, and P. P. Vasudeva Menon (p. 681). 21. A new species of the genus *Craspedoxantha* Bezzi, 1913, from India (Diptera : Trypetidae) (*With a plate*). By Md. Zaka-ur-Rab (p. 683). 22. Unusual nest-site of the Social Spider, *Stegodyphus sarasinorum* Karsch (*With a plate*). By G. J. Phanuel (p. 686). 23. An unusual method of curing scorpion stings. By Humayun Abdulali (p. 688). 24. A new species of mollusc, *Gulella rambhaensis*, from Rambha in Orissa (Gastropoda : Family Streptaxidae) (*With one text-figure*). By H. C. Ray (p. 690). 25. Ectoproctan-Coelenterate association : An example of unpurposeful inquilinism? By N. Krishna Pillai (p. 693). 26. The correct name of *Cassia glauca* and its varieties. By D. Chatterjee (p. 695). 27. *Cucumis setosus* Cogn.—A new record for Bombay (*With one plate*). By A. R. Chavan and G. M. Oza (p. 699). 28. Phyllody of the gynoecium and androecium in Ylang-Ylang Tree, *Cananga odorata* Hook. (*With a plate*). By K. V. Marathe and B. S. Navalkar (p. 700). 29. Black colour in flowers : Is there such a colour in nature? By H. Santapau (p. 701). 30. Food from grass minus the cow. By R. W. Burton (p. 702)

GLEANINGS 704

NOTES AND NEWS 707

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1959-60 708

STATEMENT OF ACCOUNTS OF THE BOMBAY NATURAL HISTORY SOCIETY .. 713

MINUTES OF THE ANNUAL GENERAL MEETING 719

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1960 DECEMBER Vol. 57 No. 3

A Visit to the Flamingos in the Great Rann of Kutch

BY
SHIVRAJKUMAR OF JASDAN,
R. M. NAIK, PH.D.,
AND
K. S. LAVKUMAR OF JASDAN

(*With three plates*)

On **16 April 1960** the three of us and P. W. Soman of the Bombay Natural History Society assembled in the Modern Hotel at Bhuj. 'A sight for the Gods' Dr. Sálim Ali had written to us describing Flamingo City which he had visited on 21 March 1960 from the bird-ringing camp at Kuar Bet and, excited by what he said, we were about to set off hoping to share in the pleasure and to seize the privileged opportunity of witnessing the spectacle. However there was deep down amidst all the enthusiasm, a mild doubt which was ever so lightly perceptible in all our minds. Had not McCann said that the Rann dries up pretty fast when it does start doing so? He had found that the water receded many miles each day, forcing the breeding flamingos to evacuate their nests, some even containing hard-set eggs and newly hatched young, while countless chicks in the running stage fall out by the wayside unable to keep up with the rapidly retreating waters and lie as mute testimony to the disasters which strike breeding populations in nature. Suppose, we asked each other, that such a catastrophe had happened? Would we merely be witnesses to one of Nature's cruel acts of profligacy? Another alternative, the voice of doubt softly whispered: 'What if the birds have hatched out their eggs and taken their broods into deeper water?'

However, these unpleasant thoughts were not allowed to choke our enthusiasm, for the bus seats for Khavda had to be reserved for the next morning, essential stores had to be purchased, and as a couple of us discovered that we lacked sunglasses to protect our eyes against the glare of the Rann we had to set about acquiring these. We therefore spent a busy afternoon in the picturesque and tortuous bazaars of Bhuj behind the thick medieval walls.

17 April 1960. The following morning we left for Khavda. The bus, a new one, was not over-crowded as most State Transport buses are. We had front seats, and the morning was pleasantly cool with a fresh breeze coming from the north. We travelled fast and soon the sandstone hills of Kutch were left behind, and the level country of the Banni's edge began. At first there were dense shrubberies of *Salvadora* and tamarisk which later thinned out and gave way to the flat featureless expanse of the true Banni. The Grey Partridge was plentiful and scuttled into cover, Common Babblers chattered among the shrubberies, and chattering flocks of Rosy Pastors migrating northward flew overhead. Redvented Bulbuls were common and White-eared Bulbuls were seen in increasing numbers. The latter seem to be very partial to *Salvadora*, and it is worthy of note that in near-by Saurashtra this pretty little bulbul is totally absent from large tracts of the interior, and is found chiefly around the coastal flats where the *Salvadora* also appears. Can it be merely a coincidence that the requirements of the bird and the plant are similar, or does the plant have an ecological influence on the bird?[1]

The Banni itself is a flat featureless expanse, a limitless plain of blue-green vegetation. The plants are short bushes with highly xerophytic characters; their fleshy leaves store large amounts of water, and are avidly cropped by camels. The Banni is a remarkable phenomenon; the plain lies but a few feet above sea-level, and is so lacking in gradient that the rain-water lies in a shallow sheet over it slowly draining into the sea, or just evaporating into the dry air. The disappearance of the water is followed by a parching dessication during the hot season, and the soil is encrusted by salt; tall dust devils race across the expanses and mirages shimmer, tantalising and cool, in every direction. This is stock-rearing country, famous for its fine herds of large-horned cattle and camels.

For the first time the large Franklin's Crested Lark appeared, several female Pale Harriers and a Marsh Harrier went gliding north, hunting as they went. We were all on the look-out for the splendid Desert Larks but saw none; instead, we saw a few Redwinged Bush Larks in patches of grass and *Prosopis*, and isolated pairs of Ashycrowned Finch Larks feeding beside the road. Some of the trenches on both sides of the road still contained watery mud choked with frogs and provided ample sustenance to flocks of Lesser Egrets, Small Egrets, Pond Herons, and solitary Large Egrets.

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[1] This association has been noted near Bombay also. See *J. Bombay nat. Hist. Soc.* **39** : 101.—Eds.

In the centre of the Banni is an extensive oasis of large shady Acacias casting deep pools of shade, cool and restful after the sun-drenched Banni. The grass was refreshingly green. Large herds of cattle and buffaloes stood around under the trees, attended by Cattle Egrets. The inhabitants are Jhads, a cattle-herding tribe. They are well-built people and, though they are Muslims, their women go around unveiled and appear to enjoy a status equal to the men.

Leaving Brindiala, as this oasis is called, and proceeding again into the dazzling brightness of the Banni, we passed a couple of small herds of Chinkara, which do not seem to be at all as plentiful as claimed; nor did we come across any Black Buck or other game, big or small. Undoubtedly the Banni no longer enjoys its former status of a small game paradise, and is certainly not behind the times in this respect compared with the rest of India; man's predation is greater and more effective than is believed outside Kutch.

The commonest animal of the Banni was the Spinytailed Lizard, *Uromastix hardwicki*, sunning itself on the baked sand. Its performance of suddenly vanishing after a short spurt was intriguing until one realised that the disappearing trick was done down its burrow. These lizards are undoubtedly the chief provender of the large numbers of passing birds of prey during the autumn and spring migrations. Certain nomadic tribes of the area consider that this lizard's flesh has strong aphrodisiac properties and regard it as a valuable delicacy. . . . And so in time for an early lunch in Khavda.

At Khavda, arrangements had been made for our stay at the police chowky. It was in a way like a home-coming, as we had been here in the summer of 1956, unsuccessfully on a similar errand, and were then as now hospitably accommodated by the local officials. Things had changed little in the intervening years and, except for a block of new orderly quarters in the large enclosure, everything was as it had been then—time might well have stood still for the period. As some high dignitaries were on a routine inspection, we saw little of the officials who had been making arrangements for guides and baggage animals to take us to Nir. The chief guide Jamal Nathu was nowhere in town, and there was no news of him. 'He might arrive this evening', they all said. Camels were also not available for hire readily. It was very depressing and it seemed that after all we were stranded. The dog all of a sudden lost its charm, and we dejectedly prepared for lunch and then to await developments in the afternoon. Just then someone said Jamal had arrived and sure enough there he was standing in the doorway, a thin dark man dressed in the manner of his people. Spirits revived and lunch was forsaken to get all information out of him. He was optimistic, as there was still plenty of water in the Rann, and large numbers of flamingos fed along its edges. They had no young with them, and so it was obvious that the birds were still at the colony site and had not moved off; the camels and ponies had also arrived and were grazing on the turf of the village tank, so we could leave for Nir the first thing next morning. The well-cooked lunch, a tribute to the long catering arm of the Modern Hotel, and a short siesta were followed by an afternoon of baggage sorting. In the cool of the evening we went for a stroll to see our pack animals, and to record what birds were around. In addition to the usual birds one sees around any village tank in Kutch, we saw a Wryneck, a little Green Heron, and a pair of Laggar Falcons.

18 April 1960. The sturdiest camel was loaded with all the baggage, three others and two ponies were to be used for riding. At 7.50 a.m. the cavalcade started across Pachham towards the north-west end of the Island where the spurs of Kala Dongar subside into soft undulations and finally give way to the flat expanse of the Rann. The entire way is well covered by scrub, and there is little cultivation. Cattle-rearing is the chief occupation, and there are signs of considerable overgrazing. The little cultivation done is of a perfunctory nature and depends entirely on the vagaries of the monsoon rains. Much of the land is deeply eroded. The thickets however were well populated by Grey Partridge, Rain Quail, Purple Sunbirds, Redvented Bulbuls, White-eared Bulbuls, Rufousfronted Wren-Warblers, Franklin's Wren-Warblers, Common Babblers, Tailor Birds, Common Mynas, Brahminy Mynas, Redwinged Bush Larks, Ring and Little Brown Doves, and Roseringed Parakeets. Common Sandgrouse were noted flighting in pairs and small parties. The heavens overhead were quartered by King Vultures, Whitebacked Vultures, Longbilled Vultures, and white Scavenger Vultures accompanied by a few Griffons. Tawny Eagles were also seen soaring in loose pairs, while in the shady Banyan over the well at Wadvala, known as Wad-vali Wav, a pair of Redheaded Merlin had three young in the nest. A pair of Laggar Falcons and a Peregrine were also recorded. At

Kakrao where we spent the heat of the day under a densely-shaded small tree, we heard and later saw a Raven. It was there on our return.

From Kakrao we rode north. After descending the last low ridge we came to the Rann, and then turned east along its edge. On our right the great escarpment of Kala Dongar rose steeply—great beetling crags covered by thick tangled scrub and grass, still showing green. Birds were plentiful, and their songs were carried in a disembodied symphony from high overhead. Indian Robins were very plentiful with Baybacked Shrikes (many in juvenile plumage) and pairs of Brown Rock Chats.

Where the slopes eased to form narrow flat areas between the perpendicular of the Kala Dongar and the horizontal of the Rann, the subsoil water was sweet, and herds of cattle were pastured, their tingling bells bringing to mind the high pastures of the Himalayas.

On our left stretched the Rann—startlingly flat and immense; first a white encrustment of salt shining in the sun, then wet mud dark brown and rich, and beyond this the blue water, rivalling the sky overhead and stretching to the horizon where it shimmered into the sky, and it was difficult to discern where one ended and the other began. Here was a region where desert and water had become one in essence, vast and limitless, a land of silence, ruled by the wind and the sun, a home of dancing mirages, a region forbidding yet fascinating in the starkness of its elemental harshness. Yet it was awe-inspiring to see on this cruel stage life playing its part in the great flocks of pink flamingos feeding in the shallows, flying in skeins low over the water or writhing high above the mirages and merging into their unreality like ethereal beings, frail phantoms epitomising life, fragile yet all-conquering. A little further we came across packed flocks of Blackwinged Stilts, Stints, Rufts and Reeves, Marsh Sandpipers, Whimbrel, Sand Plovers, and some Blacktailed Godwits. Gullbilled Terns, Blackheaded Gulls, and Brownheaded Gulls flew buoyantly over the water. Tired but happy, we rode along slowly, drinking in the sights of this improbable land. Here was grandeur and beauty rivalled by few other creations of Nature.

We made Nir late in the evening as the setting sun cast a warm glow on the wonderful landscape. The mirages subsided and far out on the northern horizon we saw lines of pink and white, which Jamal said were Flamingo City. The birds were still breeding. A memorable day had ended well, and tired and happy we lay under the brilliant stars, worn out but contented.

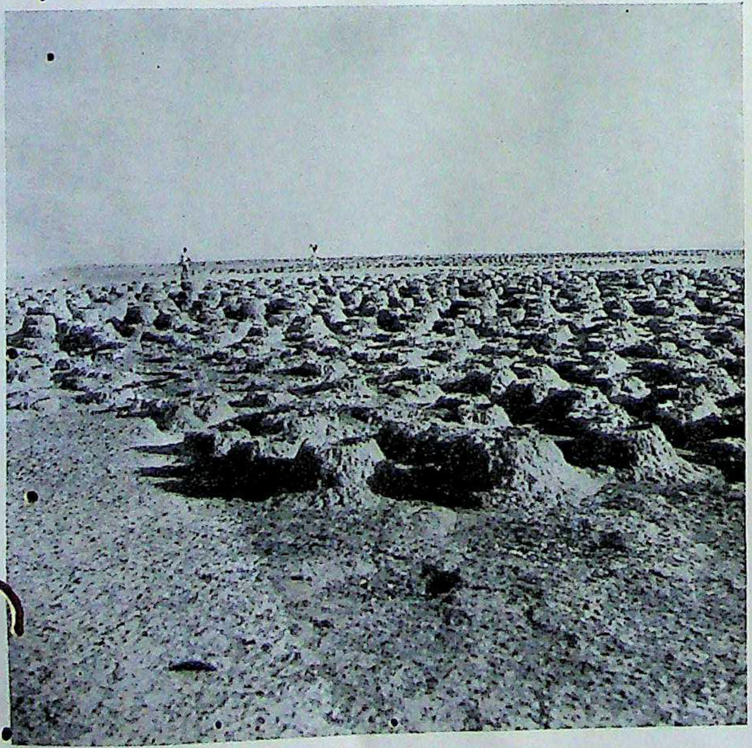
19 April 1960. The pink light of dawn rekindled the scene. In the direction of Flamingo City masses of pink would blaze up and resolve into long undulating lines of flamingos flying south to the water off Kunaria or to the west to feed on the edges of the Rann where we had already seen the vast flocks on our way to Nir.

With thrilled anticipation we broke camp, loaded the animals and after watering them, set off for the colony. The direction was north-east of Nir, and traversing a dense stand of tall *Calotropis* sp. alive with sunbirds and bulbuls, skirting a green pool of fresh water over which hovered and wheeled terns and gulls, we came to the edge of the Rann and, crossing a short expanse of wet and slippery mud in crossing which the camels fared ignominiously, we entered the water. Throughout the whole distance, some seven miles in a straight line, the water was from a few inches to a foot and a half deep, clear, and with a few shoals of varieties of small fish many of which were dead, floating belly upwards, and well preserved in the concentrated brine.

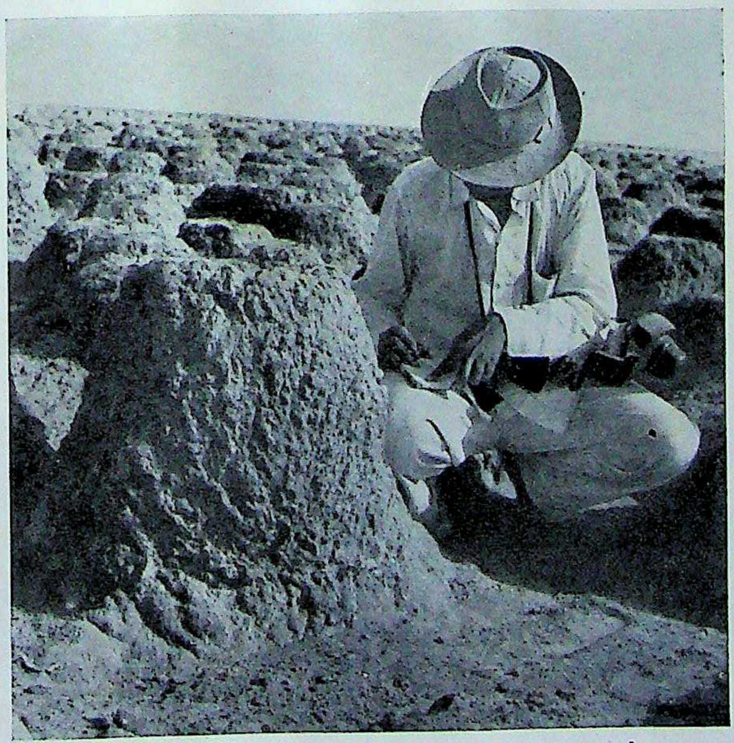
Flamingos fed singly and in small groups in all directions, while lines of birds flew by in wavering ribbons between the blue sky and the blue water sparkling in the morning light. Flocks of Gullbilled Terns and Blackheaded Gulls flew around and over us. Tight flocks of Marsh Sandpipers fed busily in the shallows and large numbers of Ruffs and Reeves, Redshanks, Sand Plovers, and Stints flew fast and low towards the north. A small group of Whitewinged Black Terns also went over.

The camels, so sure-footed and aloof on dry land, were in a hopeless condition, floundering in the wet mud; in water they fared slightly better but their pace was agonisingly slow. On several occasions they almost landed the riders and the baggage in the water. Had such an unfortunate accident occurred, the entire expedition would have been in a pretty mess indeed. The horses soon outstripped the camels and were lost in the distant haze, leaving a long black trail in the water and mud for the cumbersome 'ships of the desert' to follow as best as they could. For the horsemen the ride was a pleasant experience as they watched the birds and moved with safety and speed across the watery miles, but for those on camels the morning soon lost its sparkle and, as the haze and mirages shortened the horizons around them, the heat of the sun overhead and the glare of the water below induced a state of torpor, livened only by occasional clouds of pink as flamingos far beyond the curtain of mirages rose before the horses, or a numbed limb shot a complaint through the already strained spine. The hours slipped by, and yet we seemed to be in the same place, as in a dream. It was as if we

Flamingo colony in Rann of Kutch

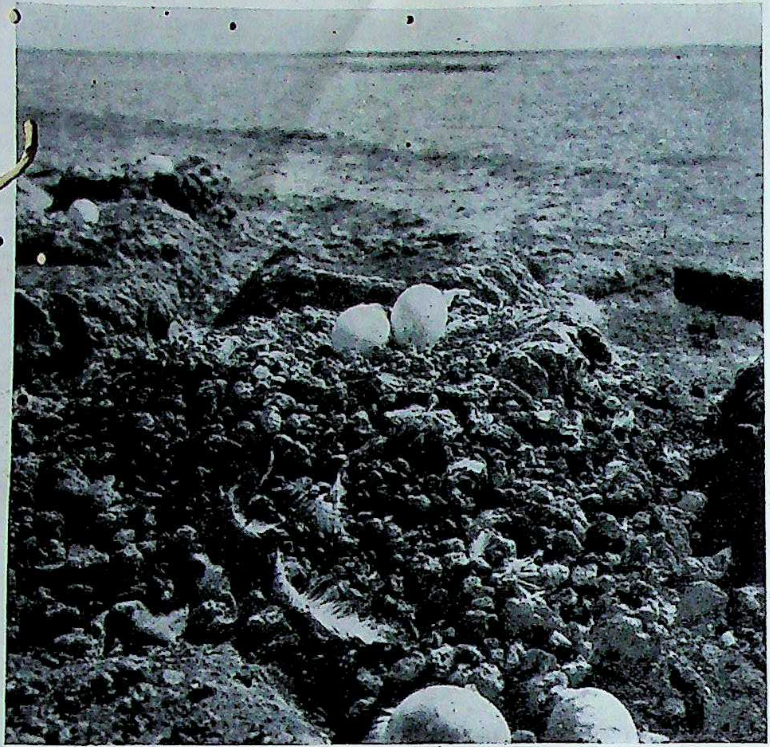


'Nests and nests for hundreds of yards'

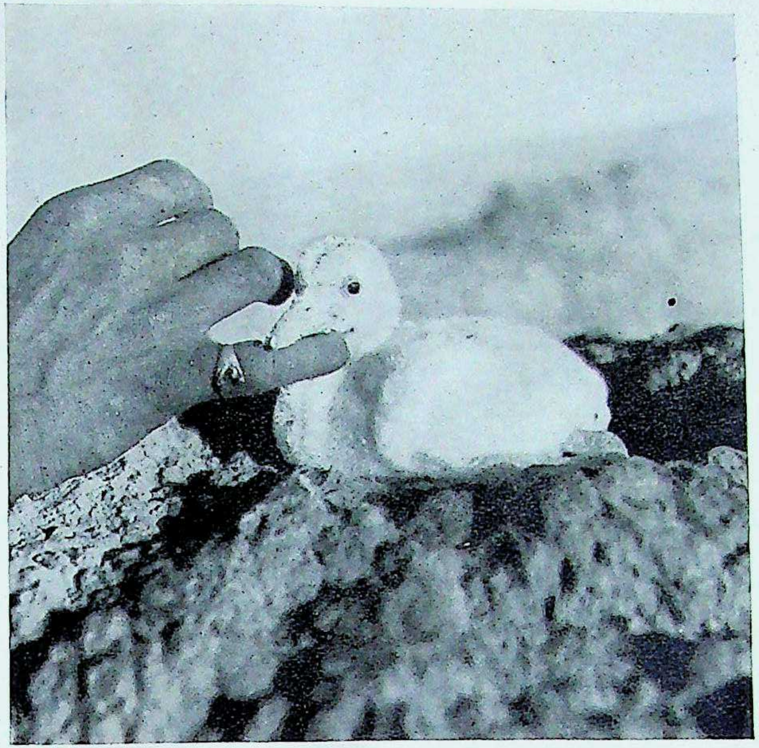


A large mound in the main colony

Photos : Authors



Flamingo nests of mud pellets with 2 eggs



Newly hatched Flamingo chick

Photos : Authors

had become one with timeless space, and everything had reached a standstill in eternity. It was therefore with some effort that it dawned on us that we had arrived. In the distance could be seen ranks of white birds. A clump of black forms making their way grotesquely across some dry sand turned out to be pelican fledglings in their black down, and the larger forms were the ponies and the rest of the party. It was all still unreal, as we came on to dry salt-encrusted sand. Getting off the camels, we walked the rest of the distance to ease our cramped legs. The sight of the flamingos was beyond belief. The fabulous birds were atop their mound-like nests, some standing and others sitting, their graceful necks curved over their backs. Every now and then, heads would rise high and pink wings would open and flash in display and the soft murmuring from the tending birds rose incessantly like distant surf on rocks. Behind the peaceful congregation of sitting birds there were in the water, now several hundred yards from the colony, rank upon rank of birds feeding with young in tightly packed rafts among their feet—a sight indeed worthy of the gods! There we sat in the blazing sun with the amazing spectacle spread before us. Years of longing had at last come true and, in a dreamlike comprehension, we scanned the great expanses of baked mud, the clustered mounds of mud nests rising from them, and the graceful pink forms poised above.

At long last we bestirred ourselves, pitched the tent for shelter from the sun, and assembled the photographic hide, and then we lay down for the afternoon. The birds were content on their nests, while files of incoming birds were met by outgoing birds, and ripples of fire would spread and subside as birds rose, stretched their wings, and settled down again. We flattered ourselves as about to achieve a long cherished hope. The birds were there, albeit fewer than those seen by the earlier party, but their numbers were still in the thousands, and above all they were ridiculously tame, or so they seemed, and took not the least interest in our tent and ourselves, though we loomed conspicuous on the flat and limitless Rann. Before sundown that day, things were to turn out differently, and a well-planned expedition was to fail on account of over-familiarity induced by the birds' own tameness. This showed us forcefully how no chances can be taken when working with wild creatures.

At 2.00 p.m. some 200 Rosy Pelicans appeared overhead. They circled around, at first high and then, in successive spirals, lower and lower, providing a magnificent display as in formation they gracefully rode the air currents revealing a mastery over the art of flight. In this manner they soared effortlessly for a couple of hours, and it was obvious that they had not taken kindly to our presence so close to their nesting ground. They finally departed, flying south from whence they had come. A few of them however circled round and landed to the north in the water. Their gawky black chicks were all in a huddle among the old flamingo nests on the southern side of the 'City', sheltering as best they could from the fierce heat of noon. Soon after, the baggage men and animals left us to our lonely vigil in the boundless spaces with the wind and the birds.

When the sun dropped to the western horizon and the heat abated, we went on our various tasks of examining the deserted section of the colony, looking over the pelican nests in which there were still many nests intact with feather lining and two eggs, deserted by the parents when the major breeding was over, and trying to capture some newly hatched flamingos for their vomit for analysis by the Society. The capturing of the young flamingos was ill-advised and should have been attempted on the very last day, as this greatly disturbed the sitting birds and they now coupled us and our manifestations with predators. The tent and all movement, which till now had caused them no concern, were now suspect. They became suspicious and it was clear that there would be a risk in attempting close range photography near the colony and, so as not to disturb the birds any further, all operations in the vicinity of the colony were stopped. The fact that the majority of the birds had left with their chicks and made for the water, which had receded from the site, must have greatly weakened the attachment of these late breeders, and any intrusion now would surely snap the slender thread of emotion holding the dwindling group of breeders together and cause them to desert. Unhappily we called it a day and decided to move our camp the next morning and watch the birds from afar. The counting of the occupied nests was to be done just prior to our departure; photography and data collection was not to be done, for fear of frightening the birds.

20 April 1960. Before sunrise the camp was shifted to the far end of the mudflat about 2000 paces from the colony. It was a back-breaking task. Under canvas, we prepared to pass the day watching and observing whatever little we could from the distance. The sun rapidly mounted in the heavens; the heat was intense, and the mirages sprang up around us obscuring the flamingos and their colony from view. Some Desert Larks arrived to hunt for insects among the cracks in the mud, and then flew off. Lost amidst the unusual surroundings, a Ring Dove alighted for a short while, while a Wryneck pretended that bits of driftwood were tree-trunks. A male Blue-headed Wagtail also paid a short visit. Flocks of Ruffs and Reeves hurtled past, and isolated groups of Stints twittered by. At noon Jamal arrived on his white pony with fresh water and curds. We had lunch off tinned fruits, and lay back as the formations of pelicans came soaring over from the south. They finally settled among the deserted flamingo nests close to their chicks, who came over to be fed; the actual process could not be seen clearly on account of the mirages. After Jamal departed for Nir we strolled across to the northern edge of the mud flat to watch the great masses of feeding birds with their chicks. Great masses of flamingos stretched along the horizon half a mile out in the water, with tightly packed clusters of dark chicks among their feet. These were in all stages of development from very small white-downed birds to brown-feathered birds several months old. The birds extended across 40° of horizon. We were thrilled to see a flock of 77 Lesser Flamingos in vivid plumage. They later flew off into the setting sun. Lines of the larger birds flew to and fro, going to and coming from the distant feeding grounds in an unending cavalcade. The sound made by the feeding birds was a constant roar like that of distant waves. The evening was a gorgeous one. At sundown, the pelicans were still with their young, clouds of midges flew over the tent, and in the deepening dusk flamingos passed low above us to the colony like the ephemeral forms of apasaras.

21 April 1960. The pelicans had spent the night with their young, many of which had been led away into the water to the north. Soon after dawn the adults left. We all went over to the colony to count the occupied nests and to do what little was possible for the cause of science. This had to be done as rapidly as possible so as not to disturb the birds for too long. No catching of young was to be done. Very soon we were back in camp, making ready to leave immediately the camels arrived.

The transport arrived at noon and they fetched with them an ever-welcome refreshment of curds. Two of us took the ponies and rode out into the water to have a closer look at the feeding adults and their chicks. The huge population of flamingos was amazing and the young were conservatively estimated at not less than half a million. Undoubtedly, this year's breeding has been the most successful ever. The abundance of water in the Rann so late in summer augurs well for the hordes of young reaching maturity.

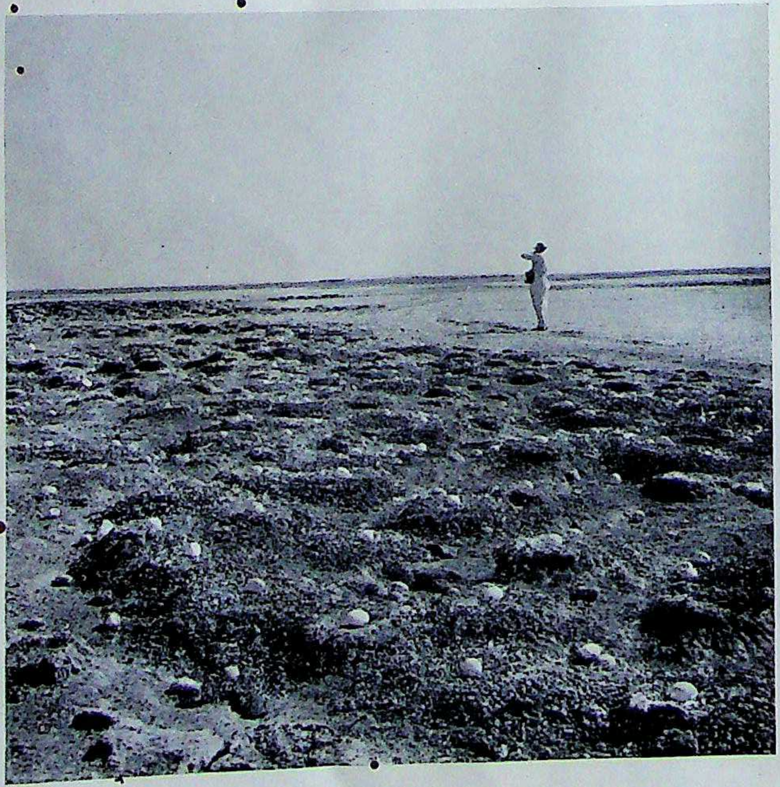
Late that night we arrived at Nir. A strong westerly wind had driven the water away from large parts of the track but Jamal assured us that as there was ample water on the east of Pachham there was no possibility of the birds being left dry even if the wind were to persist for several days. Thus ended a memorable experience, and despite the failure of our primary purpose of photographing the birds at close range, great experience had been gained. Notwithstanding the severe physical hardships endured, the next season's visit is looked forward to with keenness.

OBSERVATIONS

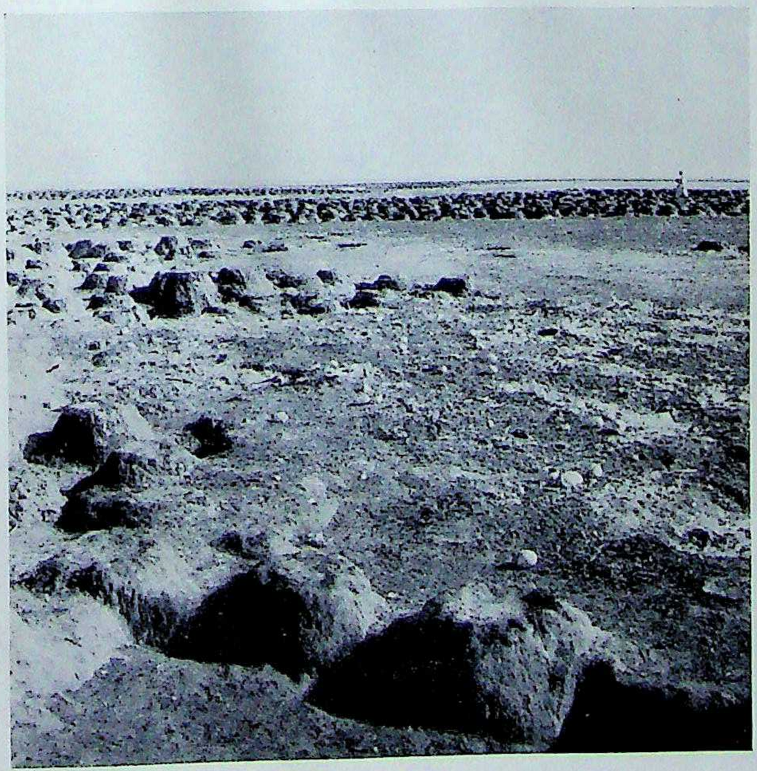
Only a portion of the breeding flamingos, reported by Dr. Sálim Ali [*J. Bombay nat. Hist. Soc.* **57** (2): 412-4] were still on the nest site. Approximately 2000 nests were still occupied. The water had receded a couple of hundred yards from the colony. The majority of the tenanted nests had obviously been constructed after the water had receded and were very low and composed of flaked pieces of mud, whereas the older nests were all tall and well-constructed or well-fashioned, and were made of smooth plastered mud. These nests were however built on the remains of the older nests, whereas some of the nests in occupation were of the taller type and suggested that they had been built earlier and must have been used twice and even thrice in the same season. It naturally is not possible to say whether the same pair were rearing supplementary broods, or whether newcomers had taken over after the original owner had vacated.

Six separate groups of nests were in habitation, but even the largest group was very insignificant beside the now vacated colonies. The largest occupied colony had an area of 1436 sq. yards, whereas the smallest was 30 sq. yards in area. In the largest colony still in use, a sample count yielded 3300 nests, of which only 1600 contained eggs, and there were 9000 eggs lying outside in heaps or smashed. Large quantities of eggs lay half buried in the mud and were not included in the count. This shows an enormous wastage of eggs, either accidentally rolled off the nests by the parents, or rolled off by predatory Neophrons. In another colony of 300 nests 30 were occupied and there were 340 eggs on the ground. However, it should be noted that the number of eggs on the ground was much less in other colonies, and in the large colonies which were unoccupied at the time of our visit the number of eggs on the ground was very much lower and even insignificant. Of course, Neophrons may have destroyed and eaten up many of these eggs in the unoccupied colonies.

The clutch was usually of one egg, though several nests contained



The largest occupied Flamingo colony. Note eggs on ground and low nests of mud flakes on remnants of older nests



Rosy Pelican eggs and nests on border of Flamingo colony

Photos : Authors

two. One egg was freakishly small measuring 41×32 mm. and weighing 17 gm.

The colony site has most certainly been in occupation since about November judging by the brown plumaged juveniles among the other chicks. The latest brood had only just commenced to hatch. Several eggs were piping and their sound was audible at a distance. The surprising fact is that these eggs and the very young chicks can withstand the severe extremes of temperature experienced on the Rann. We were struck by the intense dessicating heat during the day and the comparatively cool nights which followed. In the water, the wind, which was at all times very strong, must have proved a formidable factor for the smaller chicks. The enormous rafts of young in the shallow water always had a few adults with them, the proportion being 1 adult to 50 young and even one adult to 100 and more young. It was observed that these adults flew to water in the south for feeding and there were regular flights in the morning and evening. Why these birds had to fly so far to feed when there must have been ample food near by remains a mystery. Probably the other feeding grounds were richer than these, though these supported hundreds of thousands of young in a very small area of a few square miles. The organic content of the mud in the water where the young were feeding was 5%. This included plenty of minute organisms in the water, easily seen when held up in a glass against the light.

Predation: During favourable years death by natural factors does not seem to be very significant and the number of dessicated remains of chicks of all ages was very small and, in addition to systematic predation by two or three pairs of Neophrons on unguarded nests and isolated chicks, the greatest loss is obviously by the parents accidentally rolling their eggs off the nests, which is proved by the masses of eggs lying around in the mud. In the Great Rann predation is apparently of small consequence, as the only predators present regularly were the Scavenger Vultures, but these can hardly account for more than a small fraction of the eggs and chicks which are reared. Man does not seem to enter into the picture, as the colony is so isolated. It has however been reported that some of the villagers on the edges of the Rann do capture chicks in the running stage when the birds scatter to feed in the shallows fringing Pachham. But this can have little effect on the numbers of birds. Loss of life is mainly caused by natural catastrophes, as reported by McCann.

Nests: Nests varied considerably in size from one colony to another, but were remarkably uniform in each colony. It was obvious that nests, built when the water stood over the site, were taller and well constructed. They were more closely situated and the tops of these were from 9 to 12 inches apart. A tall nest was 23 inches high, 15 inches across at the top, and 26 inches wide at the base. The other nests were not very much smaller than this in the older colonies. Around the colonies were deep troughs made by the birds dredging mud for their construction work. The newer nests were smaller in comparison and were never more than a foot and a half tall. Mostly they were less than a foot. Neither were they as dense. The nest density varied from 130 nests per 100 sq. yards to 200 nests per 100 sq. yards in the older colonies.

Pelicans: The Rosy Pelicans which have been nesting alongside the Flamingos are a 'first' for the country, and Dr. Sálim Ali found them with eggs and newly hatched squabs. He had estimated 3000 adults busy at the operations. By the time of our visit the actual nesting had been completed, and only 200 large and ungainly young pelicans and many deserted feather-lined nests remained. The majority of the young had already been led away into the water among the flamingos, where they patiently awaited their parents, floating serenely among the wind-whipped waves. The remaining juveniles were all about the same age, very ungainly, and misshapen. They were covered with a dense black down, and only in a few of the oldest had the primaries emerged and two white bands of feathers showed on the crown. All had well-developed subcutaneous air-sacs. They spent the entire day among the old and deserted flamingo nests, huddling together for protection from the heat of the sun and the cool wind at night. They could walk well, though some of the smallest were still a little wobbly on their legs. When approached close, they turned to face the assailant and snapped viciously with their still weak bills. During the hottest part of the day they kept cool by a continual gular fluttering.

The fact that the squabs at this stage are voluntarily left by the parents, for such long periods in the blazing heat is highly significant. Bartholomew & Dawson (*Ecology* **35** : 466-472, 1954) pointed out how the behavioural responses of the adult Brown Pelican *P. occidentalis californicus* depend upon the temperature regulatory ability of the young. According to them the mechanism of temperature regulation is poorly developed in the naked newly-hatched pelicans and, for this reason, they are largely dependent on their parents for protection from the elements; adults are very attentive to their newly-hatched offspring and show a marked reluctance to leave them, and will remain at their stations even when approached to within 10 to 15 yards. With the increase in homothermy in their nestlings, the adults show a progressive decrease in attentiveness, and the behaviour of the Rosy Pelicans suggests that the temperature regulating capacity of these young was perfected. That they were also able to withstand hunger for prolonged periods was also apparent from the fact that they endured a 48-hour fast without any unfavourable reactions during the first days of our camping at the colony.

Heaps of semi-digested fish were noted around the colony and had been regurgitated by the parents[1]. A heap of average size contained 1 to 2 lbs. of fish. These were from an inch to two inches long. Some of them were collected by Soman and have been identified as *Cyprinodon dispar*.

It would be interesting to know what were the factors that led to these pelicans favouring the Rann for breeding this season, and whether they will do the same next year if the present monsoon rains prove as abundant as those of last year.

Miscellaneous: Insect life, represented by midges[2] flying over the nests and our camp, earwigs scuttling under the cracking mud, and beetles (? spp.), was plentiful. Numerous spiders stretched their webs between the flamingo nests. A hornet and a butterfly were seen but could not be collected. The enigma arises as to how the non-flying members of the insect community arrived here, especially as there are miles and miles of water separating the flamingo-flat from the nearest land.

CONCLUSION

Here for the ornithologists of India is a challenging problem. The study of the factors controlling the largest congregation of Large Flamingos in the world would be revealing. Unfortunately, the breeding cycle of this bird in the Great Rann is very erratic, and depends on the vagaries of the monsoon rains so characteristic of these parts. In addition, the colony is relatively inaccessible, and can only be reached after a long and arduous journey, during which human endurance is subjected to the severest test, and what ornithologists have done up to date is a mere collection of fragmentary evidence during their occasional visits, unhappily only too brief. A study of the Rann would therefore be interesting and needs a greater endeavour than that of the past. Prolonged stay on the site and a detailed study of the conditions of water are necessary. Small groups of birdmen could man a station at Nir and observations could be continued over the entire breeding period. This would necessitate organisation on a level which precludes the individual efforts of stray amateurs. The effort would most certainly add a tremendous contribution towards the understanding of bird behaviour and their movements and provide a landmark in the science of ornithology. It is hoped that in the not distant future Indian ornithologists will accept the challenge, and a detailed project of studies such as envisaged above will be undertaken.

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[1] Dr. Sálim Ali states that these lumps of fish were disgorged by the young. See *J. Bombay nat. Hist. Soc.* 57 : 414.—EDS.

[2] Specimens collected have been identified as Fungus Gnats (*Sciara militaris*).

Ferns of Nainital

BY

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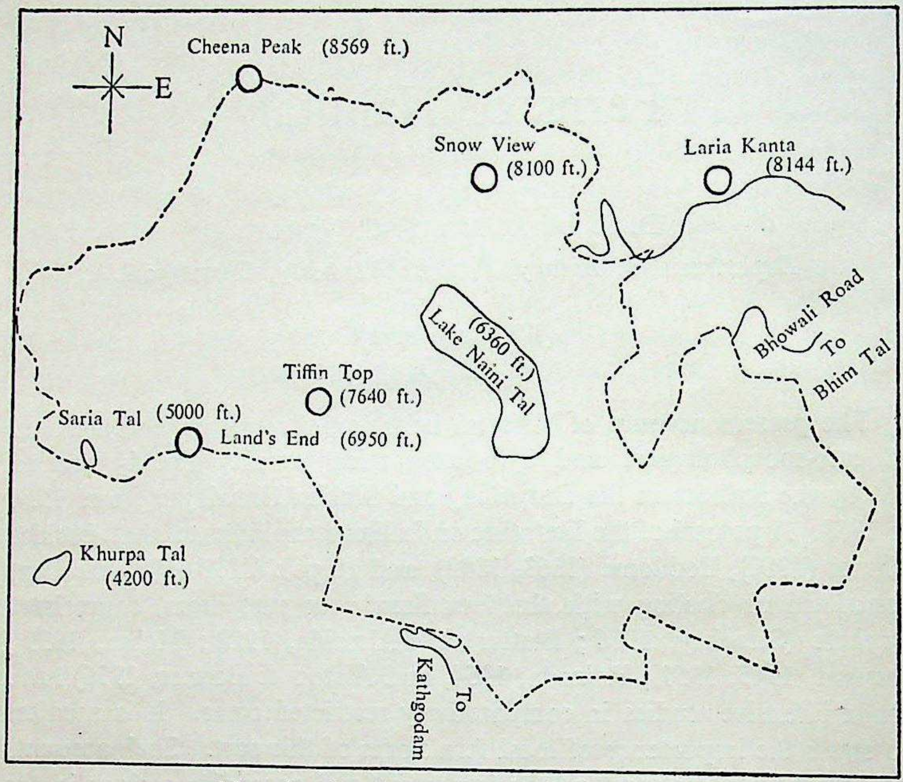
(*With one map*)

The present account of Nainital ferns is the result of an extension of cyto-morphological and cyto-taxonomical studies already carried out by the authors in the Darjeeling and Sikkim Himalayas from 1954 to 1958. A perusal of the literature on Indian ferns indicates that, besides Clarke (1880), Beddome (1863, 1892), and Hope's (1899-1903) excellent contributions dealing with the fern flora over vast areas, some later workers (Strachey, 1906 ; Blatter & d'Almeida, 1922 ; Mehra, 1939 ; Stewart, 1945, 1951 ; Raizada, 1954, and Alston & Bonner, 1956) have made intensive studies in comparatively restricted areas. It is needless to stress the importance of local fern floras of this sort. Such accounts are desirable for almost all the important and accessible regions in the Himalayas, particularly due to the revived interest in fern cyto-taxonomy. Apart from this there have recently been serious changes in nomenclature and most of the names employed in the various previous reports are no longer valid. Hence it is imperative that the new fern floras whether local or pertaining to larger areas should apply recent nomenclature. These are likely to be of great help to future collectors, especially those interested in the cyto-taxonomic aspect. It is with this idea in mind that the present investigation was undertaken by the authors. The present paper contains a list of the species collected primarily by the authors, together with their ecological notes. Other species that have not been observed by the authors but were reported earlier by Strachey (1906) from Nainital have been incorporated with a view to complete the list. These will be searched for in later visits.

The hill station was visited during July-August 1959. The altitudinal range covered is from 1700 ft. (518 m.) at Kathgodam (railway terminus) to 8569 ft. (2612 m.), the height of Cheena Peak. The present collection has been limited to Nainital proper and its neighbouring localities. Round about Nainital there are seven lakes including Nain Tal ; out of these four, namely Naini Tal, Bhim Tal, Saria Tal, and Khurpa Tal, were visited. The various mountain sides searched for ferns are shown in the map on p. 480.


N
E
Cheena Peak (8569 ft.)
Snow View
(8100 ft.)
Laria Kanta
(8144 ft.)
(6360 ft.)
Lake Naini Tal
Bhowali Road
To
Bhim Tal
Tiffin Top
(7640 ft.)
Saria Tal (5000 ft.)
Land's End (6950 ft.)
Khurpa Tal
(4200 ft.)
To
Kathgodam

Map showing the area searched for ferns

The recent system of Copeland's (1947) classification has been followed for the sake of convenience. The most recent nomenclature has been used, following Ching (1936, 1938), Copeland (1947), and Holttum (1949, 1954). It may be pointed out that Nainital proper is rather poor in fern flora so far as the number of species is concerned, though from the entire region of Kumaon Strachey (1906) has catalogued many more species. However, prolificity of certain species is well marked. For instance, *Onychium contiguum* (Wall.) Hope and *Athyrium schimperi* Moug. in certain areas cover the entire aspect of several hillocks, and amongst the epiphytes *Araiostegia pseudocystopteris* (Kze.) Copel. and *Pleopeltis kashyapii* (Mehra) Alston & Bonner are among the exceedingly common species.

CLIMATE

Nainital proper (29° 23′ N. and 79° 30′ E.) is situated in the outer ranges of the north-western Himalayas and receives an average rainfall of 98 inches (249 cm.) annually. The chief amount (70 in.=178 cm.) falls during the principal rainy months (from June to October). It is during this period that almost all the ferns bear new fronds and the fern vegetation is at its best. By about the end of the rainy season the spores are mature for dispersal. The average temperature is 58° F. (14.5° C.) during August and September. This is followed by a dry period beginning from October when the temperature falls down to 45°F. (7° C.). The winter is marked by the resting period of ferns, especially the epiphytic ones at Nainital level and above.

The soil in these mountains is comparatively loose and rich in clay covered over by humus layers in the forests. Limestone rocks are occasionally observed which are inhabited by several xerophytic species.

ECOLOGICAL OBSERVATIONS

The difficulty of classifying the vegetation type of the monsoon forests has been experienced by many previous workers. This seems particularly true of ferns, since a large number of species here show great altitudinal range and occupy diverse habitats. In such cases, therefore, no hard and fast line of demarcation is feasible. In view of this difficulty the various species have been classified on the basis of their ecological habitat.

Forest Floor Ferns

The forests around Nainital are mainly made up of *Quercus dilatata* Lindl., *Q. lanuginosa* Don, and *Rhododendron arboreum* Smith. Some of the other trees that were observed were *Acer oblongum* Wall., *Viburnum cotinifolium* Don, *Betula alnoides* Buch.-Ham., *Carpinus viminea* Wall., and *Ficus clavata* Wall. (at Bhimtal). These forests are fairly thick, and the requisite amount of moisture is available for the ground-growing as well as the epiphytic vegetation. The lofty trees provide shade and prevent rapid air movement to a considerable extent. The soil is rendered rich in humus. Under these conditions, a large number of species have been found to grow and thus these forests symbolize the climax fern vegetation of the area. In strong contrast to this, fewer species find favour in the pine and cedar forests. The commonest species recorded above 4000 ft. (1219 m.) altitude are :

Pteris cretica L.
Dryopteris odontoloma (Moore) C. Chr.
Polystichum squarrosum Don
Athyrium schimperi Moug.

Besides, *Dryopteris marginata* (Wall.) Christ and *Polystichum aculeatum* Sw. are less frequent. Forest margins and the roadsides are densely inhabited by *Cheilanthes dalhousie* Hk. and *Asplenium alternans* Wall. Wherever open situations occur, *Onychium contiguum* (Wall.) Hope forms beautiful beds and appears to be the only dominant species in such areas. *Pteridium aquilinum* (L.) Kuhn needs special mention. This species occurs as a weed over extensive usually open areas throughout the Himalayas between 4000 and 8000 ft. (1219 to 2438 m.). However, at Nainital it could only be located at some distance below the Laria Kanta peak (8000 ft.=2438 m.). Some of the open and exposed rocks on the road to Cheena Peak are colonized by *Gymnopteris vestita* (Wall.) C. Chr., popularly known to European botanists as the Mouse-ear Fern. *Phymatodes oxyloba* (Wall.) Presl. covers the shaded aspects of the entire rocks or boulders lying in the open between 6000 and 7000 ft. (1828 to 2133 m.). This fern is more of a lithophyte than of the forest floor. In contrast, however, *Adiantum venustum* Don has an aptitude for extreme shade and moisture and has been collected in plenty in the forests above 6000 ft. (1828 m.).

The roadside and the forest floor aspect at lower elevations (2000 to 4000 ft.=610 to 1219 m.) is somewhat different. The entire masonry work as well as the open forest paths are extensively colonized by *Adiantum incisum* Forsk. In contrast to this, *Adiantum lunulatum*[1] Burm. requires very moist and shaded but somewhat open aspects. The forest floor at lower elevations has a smaller variety of ferns. Amongst the commonest are :

Dryopteris cochleata (Don.) C. Chr.
Cyclosorus dentatus (Forsk.) Ching
Pteris vittata L.
Lygodium flexuosum Sw.

Another prominent species of this area is *Hypodematium crenatum* (Forsk.) Kuhn which is very partial to limestones and grows in the crevices of these rocks. The drier aspects on the roadsides are inhabited by *Cheilanthes farinosa* Kaulf. whereas *Tectaria macrodonta* (Fee) C. Chr. abounds in deep shaded and moist habitats.

Ravine Ferns

In general there are very few true ravines round about Nainital. Along Nainital-Bhowali Road several ravines were located which were almost devoid of direct sunlight. In contrast to the general forest floor atmosphere and open places, ravines are far more humid. They provide a congenial atmosphere for the hygrophytic ferns to flourish. Most of these ferns are large-sized with more or less herbaceous foliage. The commonest species that occur on the gravelly soil along the water channels are :

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[1] This is usually referred to as *Adiantum philippense* L. in recent nomenclature. The nomenclatural change adopted here will be discussed separately by the junior author.

Thelypteris erubescens (Wall.) Ching
T. repens (Hope) Ching
T. brunnea (Wall.) Ching
Diplazium polypodioides (Mett.) Bl.

Many boulders in these localities have a thick velvety covering of mosses which provide an excellent substratum for the humicoles notably *Araiostegia pseudocystopteris*, *Adiantum venustum*, *Asplenium varians*, and *Microsorium membranaceum* (Don) Ching. The common inhabitant of the ravines at lower altitudes (2000 to 4000 ft.=610 to 1219 m.) is *Cyclosorus dentatus*.

Epiphytes

While rambling in these forests it is interesting to note that epiphytic vegetation is rather poor in this part of the Himalayas, in strong contrast to comparable altitudes in the Darjeeling and Sikkim Himalayas, where the number of epiphytes is extremely large. As one proceeds westwards the epiphytic vegetation is still meagre as is evident from the recent report of Schelpe (1954) from Kulu. The rainfall in the Himalayas decreases from east to west (Darjeeling, 121.7 in.=309 cm. ; Nainital, 97.4 in. =247 cm. ; Mussoorie, 80 in.=203 cm. ; and Kulu, 43 in.=109 cm.) and this seems to be the probable reason for the paucity of epiphytic vegetation in this part of the Himalayas. The most dominant epiphytes around Nainital are :

Araiostegia pseudocystopteris (Kze.) Copel.
Goniophlebium microrhizoma Clarke
Pleopeltis kashyapii (Mehra) Alston & Bonner
P. linearis Thunb.

The only species exclusive to Nainital which has not been observed in other parts of the Himalayas is *Drynaria mollis* Bedd. It is a common epiphyte around Nainital above 7500 ft. (2286 m.). *Loxogramme involuta* Don is rather less frequent. At lower altitudes (1000 to 3000 ft.=305 to 914 m.) *Pyrrosia flocculosa* (Don) Ching is an exceedingly common epiphyte in addition to *Pleopeltis linearis*.

LIST OF SPECIES

Order OPHIOGLOSSALES

OPHIOGLOSSACEAE

1. **Ophioglossum vulgatum** L. Collected by Prof. P. N. Mehra in 1949 from Sat Tal but not collected by the authors within the area investigated ; apparently rare.

2. **Botrychium lanuginosum** Wall. Grows in patches on wayside rocks and gravelly soil on the road to Land's End and Khurpa Tal. Most of the specimens have their sterile pinnae becoming soriferous.

3. **B. ternatum** Sw. Collected by Prof. P. N. Mehra in 1949 from Laria Kanta side and also reported by Strachey (l. c.) from Nainital. Not observed by the authors.

Order FILICALES

SCHIZEACEAE

4. **Lygodium flexuosum** Sw. A common wayside scrambler near Bhujia Ghat (Kathgodam) and climbs on adjacent shrubs by the help of its stiff and wiry rachises.

PTERIDACEAE

5. **Dennstaedtia scabra** (Wall.) Moore. Reported by Strachey (l. c.) under *Dicksonia* from Nainital (alt. 6500 ft.=1981 m.) but not observed by the authors.

6. **Pteridium aquilinum** var. **wightianum** (Ag.) Tryon. Observed only in one locality below Laria Kanta (alt. 8000 ft.=2438 m.).

7. **Pteris vittata** L. One of the commonest rock-dwellers throughout the Darjeeling and Sikkim Himalayas, mostly associated with *Onychium siliculosum* (Desv.) C. Chr. and *Pityrogramma calomelanos* (L.) Link. At Nainital, however, it ranges up to 6000 ft. (1829 m.) and flourishes, even in moist and shaded situations inside the forests or even in the ravines.

8. **P. quadriaurita** Retz. Not uncommon in the forest on way to Laria Kanta (alt. 7000 ft.=2133 m.).

9. **P. cretica** L. The species can be identified in the field on the basis of marked difference in the size of its vegetative and fertile fronds. The pinnae of the vegetative ones are broader than the fertile ones with spinulose barren margins. Very common.

10. **Cheilanthes dalhousie** Hook. This is a common species around Nainital. The fronds are generally devoid of powder on the under surface.

11. **C. farinosa** Kaulf. Common all along the roadside from Bhowali to Bhim Tal on exposed rocks.

12. **C. subrufa** Desv. Only a single specimen was collected at Bhujia Ghat along the roadside; apparently rare.

13. **Cheilanthes** sp. Intermediate between *C. albomarginata* and *C. farinosa* in frond characters. Densely scaly with dense white powder underneath. Very common from Bhowali to Bhim Tal.

14. **C. albomarginata** Clarke. A common fern around Nainital and Bhowali.

15. **Gymnopteris vestita** (Wall.) C. Chr. Collected only once on way to Cheena Peak, growing on an open rocky cliff. The species can be recognized by its dense covering of soft, silvery hairs which turn brown on ageing.

16. **Adiantum capillus-veneris** L. The species has a great altitudinal range from Nainital level, down to the plains. In the plains of the Panjab it grows on shaded and moist walls in wells and streamlets. It was collected from the roadside along the Mall (Nainital) as well as at Saria Tal. Plants are rather small in size and more dark.

17. **A. incisum** Forsk. Exceedingly common between 2000 and 4000 ft. (610 to 1219 m.) forming extensive matting on masonry work and on rocks by the presence of apical buds. In the Indian literature on ferns, it has been considered as *A. caudatum* L., but it differs from true *A. caudatum* in colour, general appearance, texture, and degree of cutting of the pinnae, in having smooth apices of the sterile pinnae and larger sori, and in not having its veins raised and prominent. Collected from Bhim Tal and Bhujia Ghat.

18. **A. lunulatum** Burm. Restricted to 2000 to 4000 ft. (610 to 1219 m.) alt. Collected from several mesophytic localities such as Mehra Gaon, Bhim Tal, and Bhujia Ghat.

19. **A. venustum** Don. Excellent specimens were gathered on way to Laria Kanta and Tiffin Top; requires very humid situations.

DAVALLIACEAE

20. **Araiostegia pseudocystopteris** (Kze.) Copel. One of the commonest epiphytes in all the localities at Nainital level.

21. **Nephrolepis volubilis** J. Sm. Reported by Strachey (l. c.) at 6700 ft. (2042 m.) alt. but not seen by the authors.

ASPIDIACEAE

22. **Hypodematium crenatum** (Forsk.) Kuhn. A common xerophyte of limestone rocks; generally observed at low altitude (2000 to 5000 ft. =610 to 1524 m.).

23. **Polystichum squarrosum** (Don) Fee. A fairly common species growing along the roadsides as well as in comparatively drier forests around Nainital.

24. **P. aculeatum** Sw. It occurs under the same habitat as the former species but is comparatively less common; collected on way to Cheena Peak.

25. **P. obliquum** (Don) Moore. Collected by Strachey (l. c.) at 6900 ft. (2103 m.) alt. but not seen by the authors.

26. **Cyrtomium falcatum** Sw. (Copeland, 1947, under *Phanerophe lebia*). Reported by Strachey under *Aspidium*, at 7000 to 8500 ft. (2134 to 2590 m.) alt. Not observed by the authors; apparently rare.

27. **Dryopteris odontoloma** (Moore) C. Chr. A fairly common forest fern met with in mesophytic localities. Apparently rare eastwards. It is significant to note that in Darjeeling it inhabits only the masonry work along the roadsides and was never observed on the forest floor.

28. **D. marginata** (Wall.) Christ. This is another conspicuous species of the genus growing along with the former but can be differentiated by its large size and often tripinnate fronds.

29. **D. chrysocoma** (Christ) C. Chr. Common in mesophytic localities and known to early botanists as *D. schimperiana*, the type of which is from Abyssinia. In view of several morphological differences, Ching (1938) retains the present name for the Himalayan plant.

30. **D. cochleata** (Christ) C. Chr. It is the only species of the genus restricted to low altitudes (2000 to 3000 ft.=610 to 914 m.); also differs from other species of the area in having dimorphic fronds, the fertile ones being highly contracted. Fruits in September onwards.

31. **Tectaria macrodonta** (Fee) C. Chr. Grows on gravelly soil between 2000 and 4000 ft. (610 to 1219 m.) alt. Common near Bhim Tal and Bhujia Ghat.

32. **Thelypteris repens** (Hope) Ching. A common ravine fern. The fronds are characterized by the presence of unicellular needle-like hairs on both the surfaces. Nainital-Bhowali Road.

33. **T. erubescens** (Wall.) Ching. Grows in the same habitat as the *T. repens*; differs from it in having exindusiate sori. Nainital-Bhowali Road.

34. **T. brunnea** (Wall.) Ching. The species is characterized by

ex-indusiate sori which are slightly elongated along the veinlets. Collected only from one spot along Nainital-Bhowali Road.

35. **T. sub-villosa** (Moore) Ching. Reported by Strachey (l. c.) under *Polypodium auriculatum* ; not observed by the authors, apparently rare in the area.

36. **T. xylodes** (Kze.) Ching. Collected by Strachey from Almora and Nainital at an altitude of 5000 to 7000 ft. (1524 to 2133 m.); not collected by the authors.

37. **Cyclosorus dentatus** (Forsk.) Ching. Common in ravines descending down to the plains. Collected from Bhowali-Bhim Tal Road and Bhujia Ghat.

38. **Athyrium schimperi** Moug. Common in the forest towards Land's End. The species has a thin extensively creeping rhizome.

39. **A. falcatum**[1]. A small-sized species occupying moist but comparatively open localities on Bhowali-Bhim Tal Road and Bhujia Ghat.

40. **A. tenuifrons** Moore. Not observed by the authors, but collected by Strachey at 4000 to 7000 ft. (1219 to 2133 m.) altitude.

41. **A. rupicola** (Hope) C. Chr. Reported by Strachey ; not collected by the authors in the area investigated.

42. **A. pectinatum** Wall. Grows in open places at low altitudes. Frequently observed on way to Bhowali.

43. **A. oxyphyllum** Hook. Not collected by the authors in the area investigated.

44. **A. longifolium** Don. Not collected by the authors ; apparently rare.

45. **Diplazium polypodioides** Bl. An inhabitant of moist habitat of ravines. Collected once from a ravine along Nainital-Bhowali Road.

46. **D. japonicum** (Thunb.) Bedd. Collected by Strachey but not seen by the authors ; apparently rare.

ASPLENIACEAE

47. **Asplenium varians** (Wall.) Hk. et Grev. An inhabitant of moist boulders on way to Lari Kanta (alt. 7500 ft.=2286 m.) and Land's End.

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[1] Identification provisional.

48. **A. unilaterale** Lamk. Rare in the area.

49. **A. alternans** Wall. Exceedingly common on rocks and roadsides between 4000 and 6000 ft. (1219 to 1829 m.) altitude. Collected from Nainital, Bhim Tal, Bhowali, and Dogaon.

50. **A. exiguum** Bedd. Reported by Strachey from Nainital.

POLYPODIACEAE

51. **Goniophlebium microrhizoma** Clarke. A very common epiphyte at Nainital level.

52. **Polypodium lachnopus** Wall. A common epiphyte as well as on rocks; generally an associate of *Goniophlebium microrhizoma*. The fronds are covered with scales which are similar to those on the rhizome. In certain well-protected localities the fronds may attain a length of 2 to 3 ft. (61 to 91 cm.).

53. **Pleopeltis kashyapii** (Mehra) Alston & Bonner. An exceedingly common epiphyte at Nainital level and extends farther east.

54. **P. linearis** Thunb. Grows between 4000 and 6000 ft. (1219 to 1829 m.) alt. as a lithophyte and flourishes equally well as an epiphyte. Collected from Khurpa Tal.

55. **Lepisorus excavatus** var. **scolopendrium** (Ham.) Ching. It is a common epiphyte around Nainital; under shaded conditions it extends its rhizome horizontally beyond the trunk to expose its foliage fully, while the long wiry roots are directed back towards the moss-laden trunks for the absorption of water.

56. **Pyrrosia flocculosa** (Don) Ching. Most common epiphyte at low altitudes in several localities such as Bhim Tal, Dogaon, and Bhujia Ghat.

57. **Pyrrosia** sp. Grows in association with *P. flocculosa* but strongly differs in having more narrow, linear lanceolate and hairy fronds. On older leaves the hairs are generally brown in colour.

58. **Microsorium membranaceum** (Don) Ching. A common fern between 5000 and 7000 ft. (1524 to 2134 m.) growing on moist rocks.

59. **Phymatodes oxyloba** (Roxb.) Ching. It is an important lithophyte of the area. Collected on way to Bhowali, where it was found covering the entire aspect of a big boulder. The plants vary in size from 4 to 8 in. (10 to 20 cm.) in length.

60. **Drynaria mollis** Bedd. A common epiphyte on oak trees at 7000 to 9000 ft. (2134 to 2743 m.). Dimorphic fronds and the creeping rhizome round the tree trunks are the outstanding characters. Collected from Cheena Peak and Laria Kanta.

61. **Loxogramme involuta** Don. Collected only in one locality as an epiphyte on way to Cheena Peak. Not common.

SUMMARY

The present account on the ferns of Nainital has been incidental to the authors' cyto-taxonomic investigations in some Himalayan fern species complexes. During a short visit to Nainital in July 1959, 47 species were gathered from various habitats. The foregoing list of species also includes fourteen species that have not been found by the authors in Nainital but were reported to occur in Nainital by Strachey (1906). It may be pointed out that Strachey has mentioned only 24 species for Nainital. On the findings up-to-date, therefore, 61 species of ferns occur in Nainital. These have been arranged according to Copeland's system of classification.

ACKNOWLEDGEMENTS

The authors are deeply indebted to Prof. P. N. Mehra, D.SC., F.N.I., and Mr. R. S. Chopra for encouragement and keen interest. They are grateful to Rev. Fr. H. Santapau for kindly going through the manuscript and to Prof. R. C. Ching for the adequate literature and help in identification.

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8140
विश्वविद्यालय

Critical Notes on the Orchidaceae of Bombay State

IV. THE GENUS *DENDROBIUM* SW.

BY

H. SANTAPAU, S.J., F.N.I. AND Z. KAPADIA, PH.D.

(*With ten plates*)

[*Continued from Vol.* **57** (2) : 269]

DENDROBIUM Sw.

The generic name *Dendrobium* is derived from the Greek words 'dendron'=tree, and 'bios'=life, in allusion to the epiphytic habit of the species.

DENDROBIUM Sw. in Nov. Act. Soc. Sc. Upsal. 6 : 82, 1799, nom. cons.; Endl. Gen. Pl. 192, 1837 ; Lindl. in Bot. Reg. 46, 1844, et in Journ. Linn. Soc. 3 : 1, 1858 ; Benth. & Hook. f. Gen. Pl. 3 : 498, 1883 ; Pfitz. in Engl. & Prantl, Pflanzenf. 2 (6) : 172, 1889 ; Hook. f. Fl. Brit. Ind. 5 : 710, 1890 ; King & Pantl. in Ann. R. Bot. Gard. Calcutta 8 : 38, 1898 ; Duthie, ibid. 9 (2) : 84, 1906 ; J. J. Smith, Fl. Buitenz. 6 : 306, 1905 ; Kränzl. in Pflanzen. 45 : 25, 1910 ; Schlecht. Orchid. 246, 1927 ; Holttum, Rev. Fl. Malaya 1 : 258, 1953. *Oeraia* Lour. Fl. Coch. 518, 1790. *Callista* Lour. Fl. Coch. 519, 1790 ; O. Kuntze, Rev. Gen. Pl. 2 : 652, 1891 ; Kränzl. 313. *Desmotrichum* Bl. Bijdr. 329, 1825 (non-Kuetz. 1845) ; Kränzl. 343.

Perennial *epiphytes*. *Rhizomes* short or long, simple or branching, with pseudobulbs. *Pseudobulbs* simple, uni- or multi-nodal, from sheathing cataphylls, which, when old and dry, appear as fibrous threads at the nodes. *Leaves* deciduous or persistent, either 1 or 2 at the top of the pseudobulb or many and bifarious throughout the stem. *Flowers* solitary, in fascicles or in racemes, axillary, or from the scarious clusters of bracts at the apex of the pseudobulb. *Sepals* subequal, spreading, erect or connivent ; lateral sepals more or less connivent on the foot of the column forming a mentum ; rarely mentum absent. *Petals* equalling the dorsal sepal or larger, free. *Lip* articulate with the foot of the column, or rarely connate, entire or 3-lobed. *Column* free, short, the anterior part with a large depression, occupied by the stigma, anterior side arms short, entire or bilobed ; foot long or short, or rarely absent, more or less hollowed on the front, nectariferous at the base; rostellum small, transversely lamellate. *Anther* subglobose or conical, anterior part retuse or toothed, 2-celled, the stalk short subulate or filiform; pollinia 4, in pairs, subequal, the external ones slightly smaller. *Capsules* ovoid or obovoid.

In a broad sense Schlechter has estimated the total number of species to be in the neighbourhood of 900. This genus occurs almost exclusively in the Old World. It is distributed from India and Ceylon to southern China and Japan, southwards through Malaysia far into the Pacific and to Australia and New Zealand.

This very large and polymorphic genus has been variously divided into subgenera and sections by various authors. Kränzlin in his monumental monograph of the genus divides it into 10 subgenera. All our Bombay species (except one) are included under the first subgenus *Eudendrobium*; *D. lawianum* Lindl. goes with peloric forms under *Aclinia*. Most modern authors divide the genus into sections; we follow them. However for *D. lawianum* Lindl. we follow Lindley in reinstating the section *Aclinia*. The name of the section containing the type species, *D. crumenatum* Sw. (sect. *Eudendrobium*) must be changed to *Dendrobium* sect. *Dendrobium*, according to the Art. 22 of the Code.

Type species: *D. crumenatum* Sw.

KEY TO THE SPECIES OF *DENDROBIUM* OF BOMBAY

1. Rhizome distinct, creeping; leaf 1, from top of pseudobulb; flowers 1 or 2 borne on the top of the pseudobulb .. *macraei*
1. Rhizome not distinct; leaves several, bifarious; flowers many in racemes or in pairs, rarely solitary:
  2. Stems usually tufted forming small ovoid pseudobulb, rarely elongate; flowers in slender racemes, rarely solitary:
    3. Stems long, much branched; lip undivided or obscurely 3-lobed .. *herbaceum*
    3. Stems simple, often reduced to small pseudobulb; lip distinctly 3-lobed:
      4. Small plants with crowded, ovoid pseudobulbs; petals not broader than dorsal sepal:
        5. Leaves fleshy, coriaceous; peduncles very short, some-

what thick ; racemes arising almost directly from apex of pseudobulb ; midlobe of lip acute .. .. *peguanum*.

5. Leaves thin, membranous ; peduncles 4-5 cm. long, filiform, slender ; midlobe of lip rounded, obtuse or retuse :

    6. Lip pink with deep red-purple veins, irregularly crenulate, broader across lateral lobes than the midlobe ; midlobe small irregularly crenulate, truncate or subretuse .. *microbulbon*

    6. Lip pale yellow or yellowish-green, ± suffused with pink, equal to or narrower than midlobe ; midlobe of lip suborbicular, with 2 rows of stiff, glandular hairs on margin, rounded or subemarginate *mabelae*

4. Larger plants with elongate pseudobulbs (rarely uninodal) ; petals much broader than the dorsal sepal :

    5. Flowers cream-coloured, about 1.5 cm. across ; lip about 8 mm. long, the disc with pale green hairs all round ; midlobe of lip somewhat quadrate-rounded .. *ovatum*

    5. Flowers pure white, or tinged with pink, or often strongly rosy-pink, about 2.5-4 cm. across ; lip 23-30 mm. long, the disc with pale yellow hairs at its base and apex only ; midlobe of lip broadly ovate, or ovate-oblong or rarely subflabellate .. *barbatulum*

2. Stems elongate, clavate or nodose ;

flowers in lateral pairs or fascicles, rarely solitary :

3. Flowers zygomorphic ; mentum distinct ; column with a distinct foot :

  4. Flowers pale cream-yellow, lip with red or purple nerves ; mentum about half as long as dorsal sepal or longer ; lip entire or hardly lobed, minutely serrate, fimbriate, hairy .. *macrostachyum*

  4. Flowers pale watery-green, lip pale yellowish on the inside ; mentum less than half the length of dorsal sepal ; lip 3-lobed ; lateral lobes broad, obovate-oblong rounded, ascending ; midlobe deflexed and contracted inwards at the base slightly ciliate .. .. .. *aqueum*

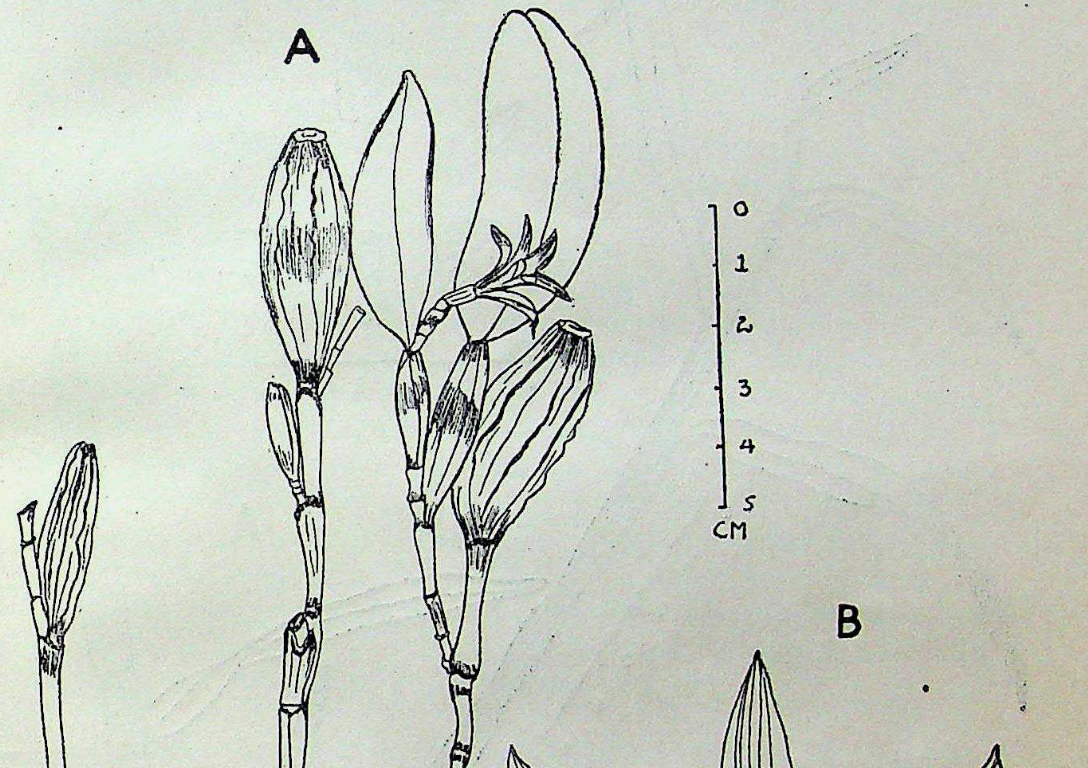
  4. Flowers white or suffused with pale rose, lip with a yellow patch at the base ; mentum very small ; lip subentire, obscurely 3-lobed ; lateral lobes small forming a small pouch at the base ; midlobe spreading, oblong-round, puberulous .. *crepidatum*

3. Flowers subregular ; mentum absent ; column without a foot .. .. *lawianum*

ENUMERATION OF THE SPECIES OF *DENDROBIUM* OF BOMBAY STATE

1. **Dendrobium macraei** Lindl. Gen. Sp. Orch. 75, 1830, et in Journ. Linn. Soc. 3 : 6, 1859; Dalz. & Gibs. Bomb. Fl. 260, 1861 ; Hook. f. 714, (partim) ; Grant, Orch. Burma 104, 1895, (partim) ; King & Pantl. 61, t. 86 ; Gammie in Journ. Bombay nat. Hist. Soc. 16 : 566, 1905 ; Cooke, Fl. Pres. Bomb. 2 : 680, 1807 ; Brühl, Guide Orch. Sikk. 66, 1926 ; V. Narayanaswami in Journ. Ind. Bot. Soc. 25 : 215, 1946. *D. nodosum* Dalz. in Hook. Journ. Bot. 4 : 292, 1852. *D. rabani* Lindl. in Journ. Linn. Soc. 3 : 7, 1858. *D. pardalinum* Reichb. f. in Gard. Chron. 11 : 230, 1885. *Callista macraei* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 655, 1891. (See Plate XVI)

Stems long, creeping, annulate, profusely branching ; branches polynodal, more or less trigonous or terete, smooth, shining, yellowish-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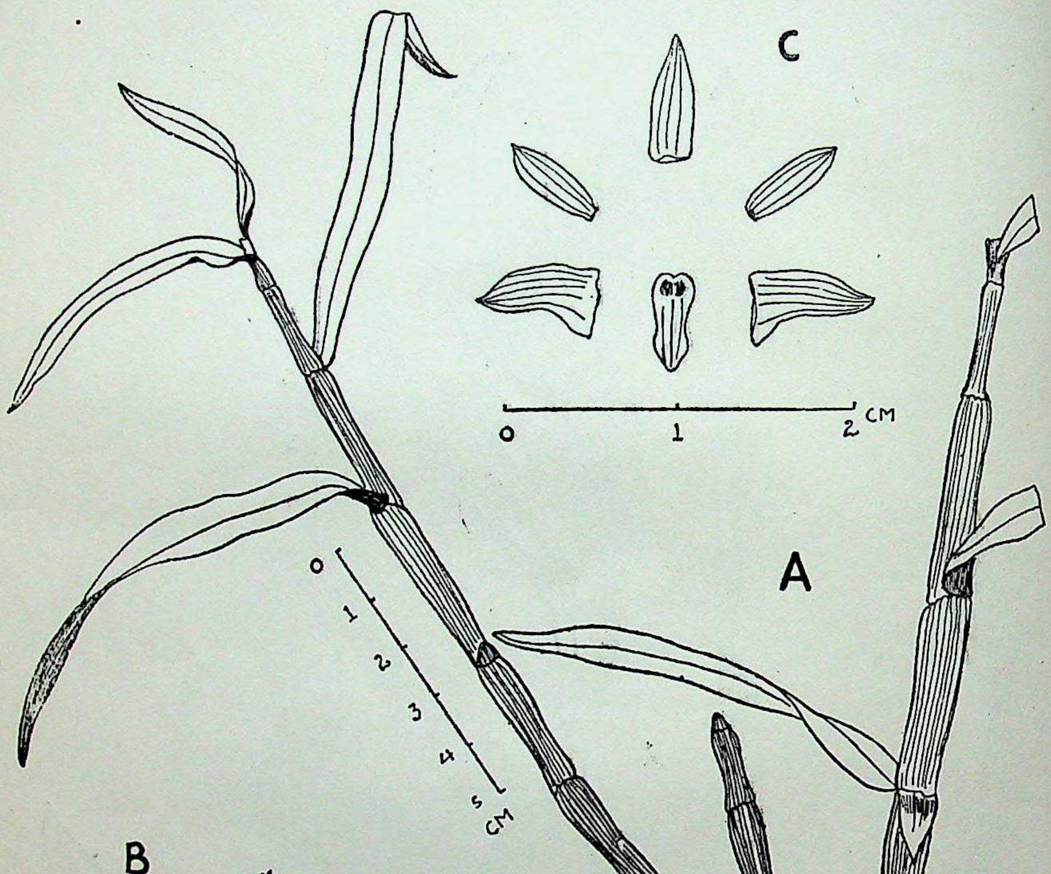
Dendrobium macraei Lindl.
A. Whole plant ; B. Perianth segments.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Dendrobium herbaceum Lindl.
A. Leafy plant ; B. Flowering plant ; C. Perianth segments.

brown, ending in pseudobulbs. *Pseudobulbs* 2-8×0.5-2 cm., linear-oblong, fusiform, green or yellow, terete or compressed, and sulcate when dry. *Leaf* 4-10×1-2.5 cm., solitary, sessile, very coriaceous, 1-nerved, ovate-lanceolate or oblong-elliptic, acute, obtuse or rarely subretuse. *Flowers* one or rarely two, lasting for less than a day, from the axil of the leaf, on a stalk 6-7 mm. long, which is sheathed at the base with several scarious bracts. *Floral bracts* at the base of the ovary about 3 mm. long, oblong-lanceolate. *Ovary* with the short *pedicel* 5-6 mm. long, subclavate, pale yellow, ridged, separated from the stalk by the bract. *Sepals* 12 × 4 mm., white, very slightly suffused with pink and yellow, ovate or ovate-oblong, acute, faintly 5-nerved ; mentum blunt, slightly retuse, at right angles to the ovary, about 4 mm. long, pale creamy-yellow with a few reddish spots at the back towards the apex. *Petals* equalling or slightly shorter and narrower than the sepals, similar to the latter, faintly 3-nerved. *Lip* obovate in outline, about 13 mm. long, white speckled with red on both the surfaces, 3-lobed ; lateral lobes 10-11 × 2 mm. erect, narrowly oblong, obtuse ; the 2-winged apex separated from the lateral lobes by 1-2 mm. long subplicate claw, the wings erect in the flower, about 1 cm. across, oblong-elliptic, truncate or rounded at the apex ; the 2 lamellae reddish, along the centre to the end of the lateral lobes, much plicate. *Column* 2 × 1.5 mm., oblong, yellowish white, irregularly serrulate on top (i.e. margin of the clinandrium). *Stigmatic surface* broad, oblong-orbicular, margined with red. *Anther* small, pale yellowish white.

Leaves : persistent throughout the year. *Flowering :* July to August.

Occurrence in Bombay State : W. GHATS : Mahableshwar, *Cooke* ; Koina Valley, *Cooke* ; *Birdwood* ; Ramghat, *Dalzell & Gibson.* N. KANARA : Joida Kumbelli Mines, about 12-15 miles from Supa, *Kapadia* 2575-2827 ; Sampkhand, *Woodrow* ; Castle Rock, *Kapadia* 2824-2827 ; Gundh Anshi, *Pirson* ; Siddhapur, *V. Patel* 1849 ; *Kapadia* 2362-2364 ; Anmod, *Kapadia.*

Distribution : *India* : Sikkim, Khasia Hills, W. Ghats of Bombay State and S. India, N. Kanara. *World* : Ceylon, India, and Burma.

Notes : At Anmod in N. Kanara, this species is locally known as 'Ruttun-purush' and is much valued in the local market, where it is sold for a high price ; this plant is extensively used by the local population for making a much-valued 'Halwa' (sweet preparation).

This species has been included by Kränzlin, Fischer (*Fl. Pres. Madr.* 1412, 1928), and Blatter & McCann (in *Journ. Bombay nat. Hist. Soc.* 35 : 265, 1931) under the genus *Desmotrichum* Bl. and has been considered to be synonymous with *Desmotrichum fimbriatum* Bl. V.

Narayanaswami has elaborately discussed the problem and has conclusively shown that : '(1) *Desmotrichum* Bl. may perhaps be retained as a sectional name for a very limited group of *Dendrobia*, consisting usually of a primary creeping stem with several polynodal branches, each branch ending in a monophyllous pseudobulb and with a solitary axillary flower, but it is preferable to sink it under *Dendrobium.* (2) *Dendrobium* of Swartz is a sufficiently comprehensive genus and also embraces the species described under *Desmotrichum* Bl. There is not much difference to distinguish the latter generically from the former. This view has been accepted by Blume himself, and *Desmotrichum* has been included by him under *Dendrobium.* (3) *Dendrobium macraei* Lindl. is the valid name for the widely distributed Ceylon species and includes under it and is conspecific with *Den. nodosum*, *Den. rabani*, *Den. pardalinum.* It is entirely different from *Des. fimbriatum* Bl. (4) *Den. plicatile* Lindl. is the earliest valid name for *Des. fimbriatum* Bl. and is conspecific with *Den. flabellum* Reichb. f., *Den. kunstleri* Hook. f., *Den. binnendijkii* Reichb. f., and *Den. fimbriatum* Lindl. (5) Confusion in synonymy originated in the Fl. Brit. Ind., wherein under *Den. macraei* Lindl. the following were included, namely *Des. fimbriatum* Bl., *Den. flabellum* and *Den. binnendijkii* Reichb. f. (6) In the *Pflanzenreich* 3 separate species of *Desmotrichum* were created from the species mentioned in (4) above, to one of which *Den. macraei* Lindl. was reduced. (7) In the Indian floras, published subsequent to the Fl. Brit. Ind. the changes introduced in *Pflanzenreich*, were adopted apparently without scrutiny.'

2. **Dendrobium herbaceum** Lindl. Bot. Misc. 69, 1840, et Misc. 58, 1844 ; Hook. f. 719 ; Prain, Beng. Pl. 1006, 1903 ; Gammie 17 : 32, 1906 ; Cooke 682 ; Kränzl. 72 ; Haines, Bot. Bih. Or. 1173, 1922 ; Fischer, Fl. Pres. Madr. 1416, 1928 ; Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35 : 263, 1931. *D. ramosissimum* Wight, Icon. 5 (1) : 6, t. 1648, 1851 ; Dalz. & Gibs. 261. (See Plate XVII)

Large, pendulous or erect epiphytic herbs. *Pseudobulbs* 30-90 cm. long, much branched, 7-15 mm. thick, thin at the base, thickening upwards ; primary ones naked ; internodes 3.5 cm. long, deep purple-brown, or brown, or brown-yellow, shining and polished, deeply ridged and furrowed ; lateral branches leafy or not at the time of flowering, green or yellowish green, sheathed. *Leaves* 3-11 × 0.4-1.3 cm., sessile, sheathing at the base, caducous, alternate, distichous, linear-oblong or linear-lanceolate, acute or subobtuse, entire, glabrous. *Inflorescence* appearing after leaf-fall, short, 2-5-flowered, terminal. *Peduncles* 7-15 mm. long, brownish green, slender, glabrous, sheathed at the base ; sheaths very small, membranous, oblong, subacute, entire, translucent, glabrous. *Flowers* 7 × 10 mm., greenish white, pedicellate, bracteate. *Bracts* 3 × 1 mm., persistent, membranous, translucent, semi-amplexicaul, brownish white, ovate-oblong or oblong, acute or subobtuse, entire, glabrous, 1-nerved. *Pedicels* with ovary 12 mm. long, about 0.5 mm. in diam., pale green, glabrous. *Sepals* greenish white, oblong-lanceolate, subacute, with a minute mucro just below the apex, entire, glabrous, 3-5-nerved ; dorsal sepal 7×2.5 mm. ; lateral ones 7×2.5 mm., 4 mm. broad at the base, subfalcate, connate along the foot, forming the mentum ; mentum 3-4 mm. long, broadly funnel-shaped, rounded, enclosing the lip at the base. *Petals* 6×2 mm., greenish white, linear or linear-oblong, acute, entire, glabrous, 3-5-nerved. *Lip* 5×2.5 mm., greenish white, curved at the base, oblong-ovate in general outline, constricted somewhat below the middle, entire, 3-5-nerved, obscurely 3-lobed ; the lateral lobes narrow, obsolete, slightly turned upwards along the margins ; terminal lobe ovate or ovate-triangular, obtuse. *Column* 1×1 mm., greenish white, the lateral arms produced above into broad subentire obtuse wings, which completely cover the anther at the back except for a narrow linear-oblong space ; from the base of the opening a short, filiform process is given out to which the back of the anther is attached ; foot 2-3 mm. long, pale green, curved, obtuse. *Anther* white, 1.25×1 mm., oblong-suborbicular, retuse. *Stigmatic surface* green, rounded, deep-seated in the column ; rostellum white, narrowly transversely-oblong. *Capsule* 1.8×0.4 cm., narrowly fusiform, broad at the apex, sharply tapering at the base into a long pedicel, brownish green, somewhat 3-angled with yellowish ribs.

Leaves : June to September. *Flowering* : September to October. *Fruiting* : November to April.

Occurrence in Bombay State : KONKAN : *Dalzell & Gibson* ; Bombay, cultivated, *Kapadia* 1623-1628. W. GHATS : Mahableshwar, *Woodrow* ; *Cooke* ; *Acland* ; *Kapadia* 599, 1925 ; *Santapau* 23440. DECCAN : Manched—Bhimashankar, *Kapadia* 1451-1456. N. KANARA : Anmod, *Sedgwick*.

Distribution : Parasnath, Bengal, Godavari district, Konkan, W. Ghats of Bombay, Mysore and Madras States from 600 to 1200 metres.

Notes : Gammie mentions that this species flowers in the hot weather ; this seems to be very unusual, and we have found it in flower only in the latter part of the monsoon.

3. **Dendrobium peguanum** Lindl. in Journ. Linn. Soc. 3 : 19, 1859. *D. pygmaeum* Lindl. Gen. Sp. Orch. 85, 1830, et Bot. Reg. misc. 62, 1844 ; Hook. f. 717 ; Grant 116 ; King & Pantl. 43, t. 58 ; Kränzl. 83 ; Haines 1173 ; Brühl 55 (non Smith ex Rees, 1808 ; nec A. Cunn. ex Hook. 1836). *Callista pygmaea* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 655, 1891. *Dendrobium microbulbon* Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35 : 262, (partim) f. 7, 1931, (non A. Rich. 1845). (See Plate XVIII)

Pseudobulbs 1-6 cm. long, ovoid-conical to oblong-ovoid, stout, up to 2 cm. in diam., usually 2-4-noded, sheathed, pale green or yellowish green ; sheaths membranous with prominent veins. *Leaves* 2-4, coriaceous, 2.5-5 × 0.6-2 cm., sessile, broadly elliptic or elliptic-oblong, subacute or obtuse, 1-nerved. *Racemes* 1-5, almost directly arising from the apical part of the pseudobulb, with a few scarious, sheathing bracts at the base, 1-many-flowered, up to 7 cm. long. *Flowers* about 12 mm. long, shortly pedicellate, bracteate, faintly perfumed. *Bracts* 5 mm. long, dry, membranous, persistent, narrowly linear-lanceolate, entire, 1-nerved. *Ovary* with pedicel about 6-7 mm. long, curved, pale green or purplish. *Sepals* 8 × 2-2.5 mm., pale green or faintly suffused with pink, oblong, slightly dilated in the middle, sharply acute, entire, 3-nerved ; mentum 4-4.5 mm. long, narrowly conical, curved, subacute. *Petals* 8 mm. long, white, faintly 3-nerved, subacute, obspathulate, 2 mm. broad a little behind the apex, tapering to 4 × 1 mm. claw. *Lip* 8 mm. long, pale green ; midlobe suffused with amethyst or purplish, 3-lobed, with a small, 1-2 mm. long claw, obovate-deltoid in outline ; lateral lobes erect, more or less connivent over the column, 5 × 1-1.5 mm., narrow, with a straight grooved disc in between continuing from the claw up to the midlobe, veins faint ; midlobe 2-2.5 × 2 mm., slightly decurved, more or less orbicular or broadly triangular in outline, acute (often appearing retuse in pressed specimens), the margins crenulate, curving upwards. *Column* 3 × 2 mm., narrowly oblong, white ; foot 3 mm. long, conical, the base with a small pouch. *Anther* 1.25 × 1.25 mm., pale amethyst, its anterior lip minutely pectinate ; pollinia 1 mm. long, golden-brown. *Capsules* about 7 × 4-5 mm., deep chocolate-brown, ribbed, on a very short pedicel.

Leaves : June to October. *Flowering* : October to December. *Fruiting* : December to March.

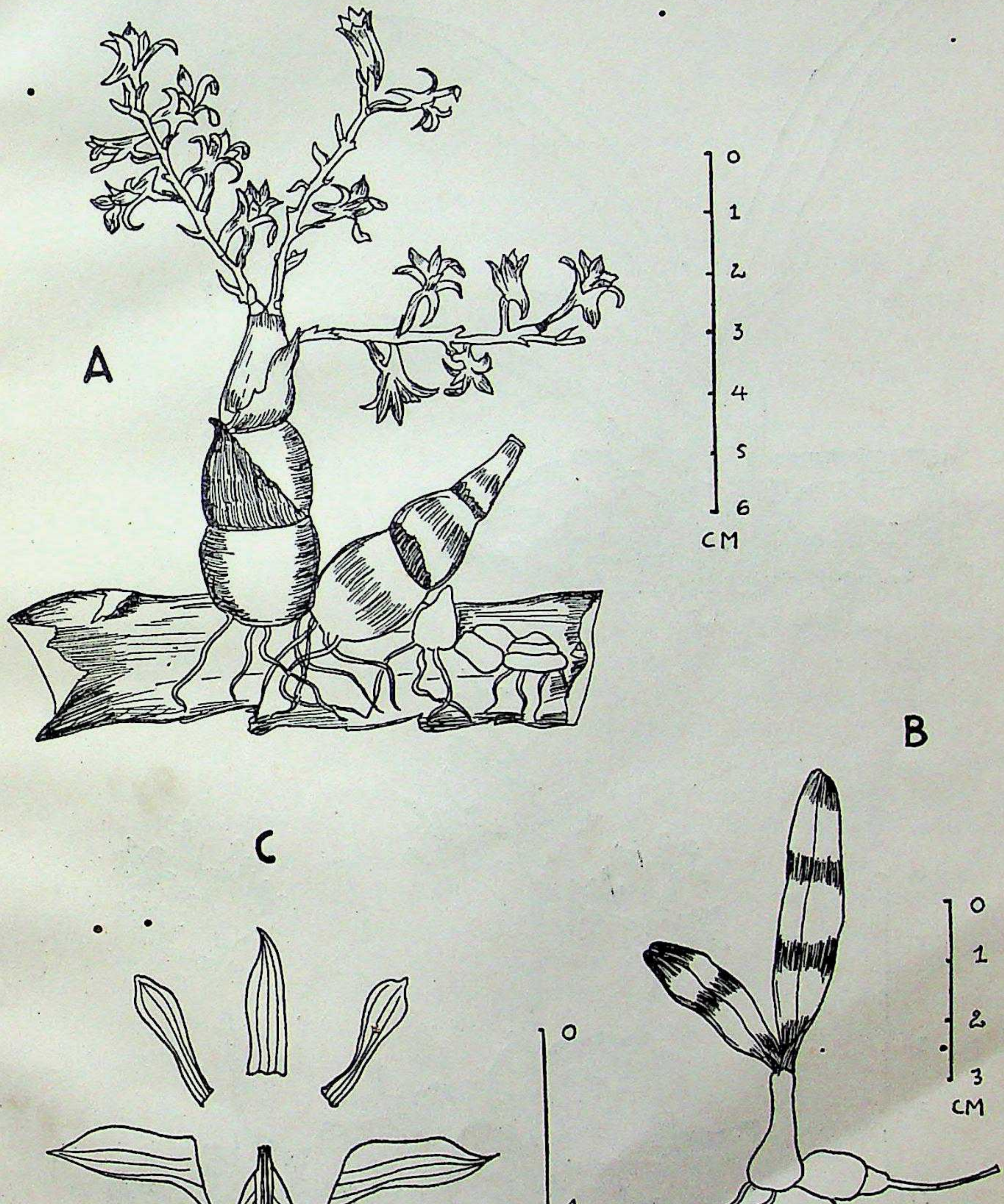
Occurrence in Bombay State : DANGS : Pimpri, *Kapadia* 1600-1601 ; Ahwa, *Kapadia*. KONKAN : Thana, cultivated, *Kapadia* 1104 ; Atgaon-Tansa, *Kapadia* 724-726, 1635-1636. W. GHATS : Kasara-Igatpuri, *Kapadia* 1375. N. KANARA : Dandeli, *Kapadia* 1665 ; Dharwar, *Sedgwick* 3788.

The plant has been recorded for the first time from Bombay State.

Distribution : *India* : Sikkim Himalaya, Jaspur, Dangs, Konkan, W. Ghats and N. Kanara. *World* : India and Burma.

Notes : We have usually found this species epiphytic on *Tectona grandis* L. f.

This species is similar to *D. microbulbon* A. Rich. and may be confused with it. However, it can easily be distinguished by its broader, coriaceous leaves and the smaller, compact, dense racemes arising almost directly from the apical part of the pseudobulb. Blatter & McCann seem to have mixed up the two species, as evidenced by their fig. 7, and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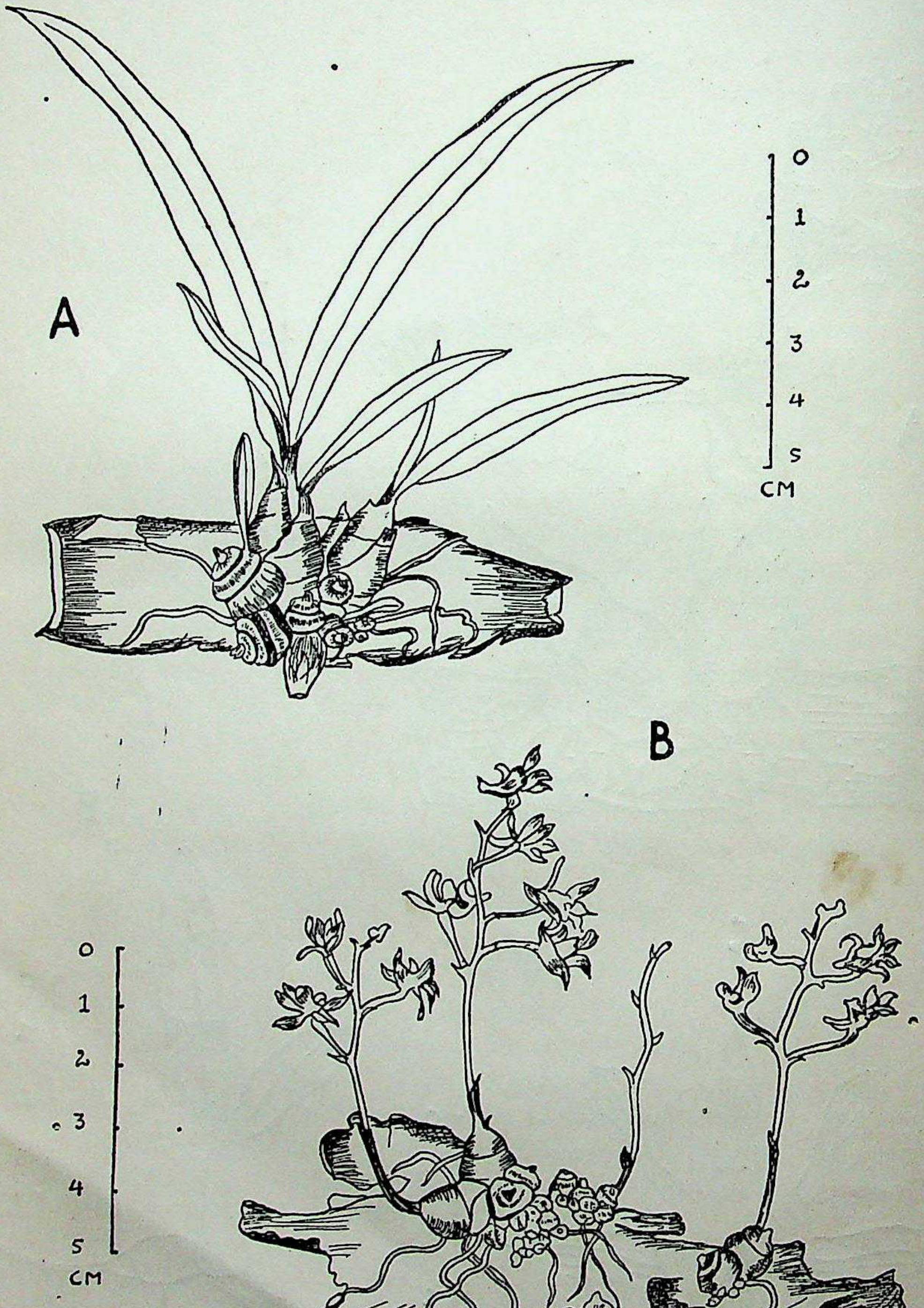
Dendrobium peguanum Lindl.

A. Flowering plant; B. Leafy plant; C. Perianth segments,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Dendrobium microbulbon A. Rich.
A. Leafy plant ; B. Flowering plant.

also by the citation of *Sedgwick* 3788 under *D. microbulbon* A. Rich.; Sedgwick's plant clearly belongs to *D. peguanum* Lindl. (=*D. pygmaeum* Lindl.).

This species goes under the name of *D. pygmaeum* Lindl. in our Indian floras, with *D. peguanum* Lindl. as a synonym. But *D. pygmaeum* Lindl. (1830) is a later homonym of *D. pygmaeum* Smith (1808); the correct name for the plant is, therefore, *D. peguanum* Lindl.

4. **Dendrobium microbulbon** A. Rich. in Ann. Sc. Nat. ser. 2, 15 : 19, t. 8, 1841 ; Lindl. in Bot. Reg. 61, 1844, et Journ. Linn. Soc. 3 : 19, 1859 ; Dalz. & Gibs. 261 ; Hook. f. 716 ; Gammie 16 : 567, 1905 ; Cooke 681 ; Kränzlin 29, f. 3 T ; Fischer 1415 ; Blatt. & McC. 261 (partim, non f. 7). *D. humile* Wight, Icon. 5 (1): 5, t. 1643, 1851. *D. crispum* Dalz. in Hook. Journ. Bot. 4 : 111, 1852. *Callista microbulbon* (A. Rich.) O. Kuntze, Rev. Gen. Pl. 2 : 255, 1891. (See Plate XIX)

Small *epiphytes*. *Pseudobulbs* 1-2 × 1 cm., crowded, mauve-brown, leafless at the time of flowering and covered with a network of fibres formed by the decayed membranous sheaths, conical, 1-3-jointed. *Leaves* caducous, appearing in the monsoon before the flowers, rarely with them ; 2-14 × 0.3-1.3 cm., sessile, sheathing at the base, thin, linear-lanceolate to oblong-lanceolate, acute, entire, 1-nerved. *Inflorescence* in racemes 1.5-10 cm. long, erect, 1-3 arising from the terminal portion of the pseudobulb ; peduncles 1-6 cm. long, purplish brown, slender with a few oblong, acute, membranous pale brown sheaths. *Flowers* 10-12 × 7-8 mm., faintly perfumed, pedicellate. *Bracts* 2-3 × 1 mm. scaly, membranous, light brown, semi-amplexicaul, ovate-lanceolate, acute, entire, glabrous, 1-nerved. *Pedicel* with *ovary* 7-10 mm. long, pale brownish green, glabrous, faintly grooved above. *Sepals* white, entire, glabrous ; midnerve prominent, lateral pair faint ; dorsal sepal 4-6 × 2 mm., slightly shorter than the petals, erect, linear-lanceolate, rarely somewhat dilated a little beyond the middle, subacute ; lateral sepals 5-7 × 3-4 mm., spreading, broad at the base to form the mentum, falcate, acute or subacute, somewhat recurved ; mentum 6 × 4 mm., broadly infundibuliform at the mouth, narrowed to a fine, slightly upturned purplish apex, white flushed with purple downwards. *Petals* 8 × 1.5 mm., white, spathulate or oblanceolate, subacute or obtuse, entire, glabrous, faintly 3-nerved. *Lip* 4 × 5-5.5 mm., fused for about 1-2 mm. to the apex of the foot, curved, clawed 3-lobed ; claw narrow, 2 mm. long, pale mauve ; lateral lobes 5 × 1 mm., erect, more or less parallel with the column, linear, acute, entire, pale purplish green with many purple nerves on the inside ; midlobe 2 × 4 mm., white flushed with pink-purple with a few deeper-coloured nerves, transversely oblong-orbicular, truncate or slightly retuse at the apex, margins irregularly denticulate ; disc narrow, pale green, with 3 green parallel nerves, terminated by a slightly widened, free, 2-lobed callus. *Column* 2 × 1.5 mm., pale mauve-green, produced below into a 6 mm. long, pale purple, shallowly grooved foot ; lateral arms white, acute. *Anther* very small, pink-purple, suborbicular ; pollinia 4, waxy, linear, yellow. *Stigmatic surface* pale green lined with purple-brown. *Capsules* 10 × 6 mm., ovoid ; pedicels 3-5 mm. long, slender.

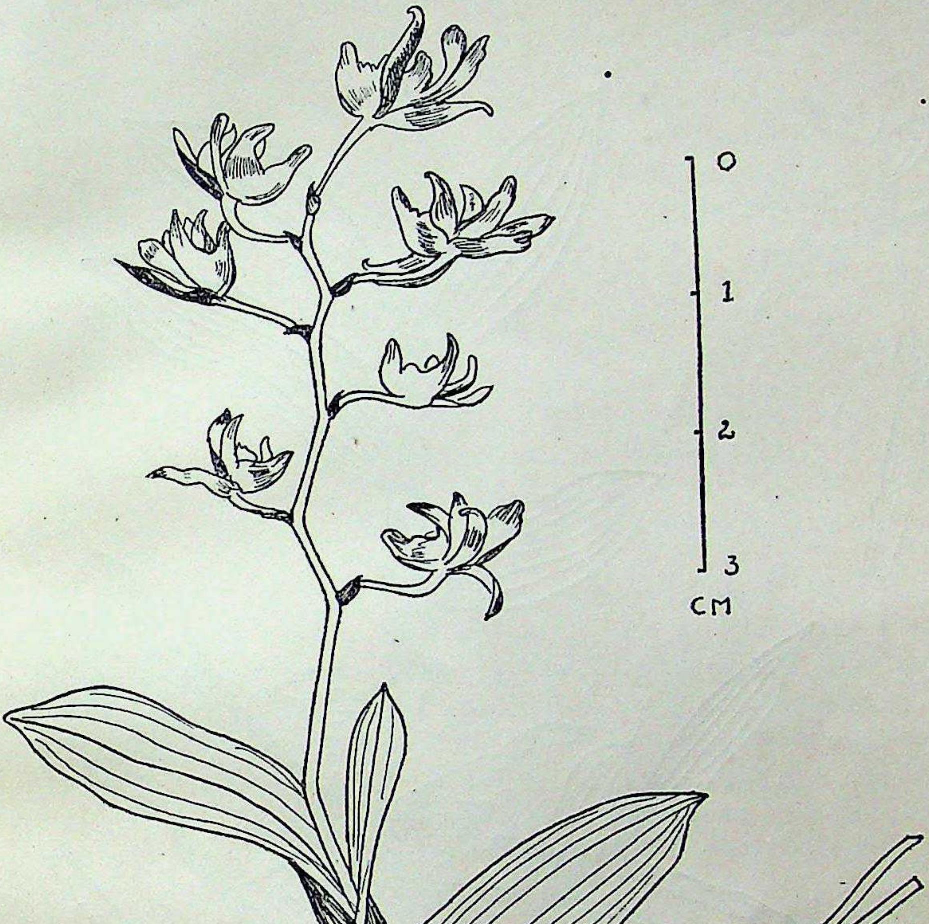
Leaves : July to October. *Flowering* : December to January. *Fruiting* : January to May.

Occurrence in Bombay State : KONKAN : *Stocks* ; Thana, *Bell.* W. GHATS : Kasara—Igatpuri, *Kapadia* 1374 ; Khandala, *Santapau* 253.30, 1037, 1439, 2452, 4363, 4600, 4740-4742, 5049 ; *Kapadia* 524, 1096-1097, 1235 ; Lonavla, *Kapadia* 536 ; Mahableshwar, *Cooke* ; *Sedgwick* ; *Ezekiel* ; *Millard* ; *Chibber* ; *J. Fernandez* ; *Santapau* 13134 ; *Kapadia* 596, 2057. DECCAN : Purandhar, *Santapau* 11456 ; *Kapadia* ; Bhimashankar, *Kapadia* 1447. N. KANARA : Amboli Ghat, *Bell.*

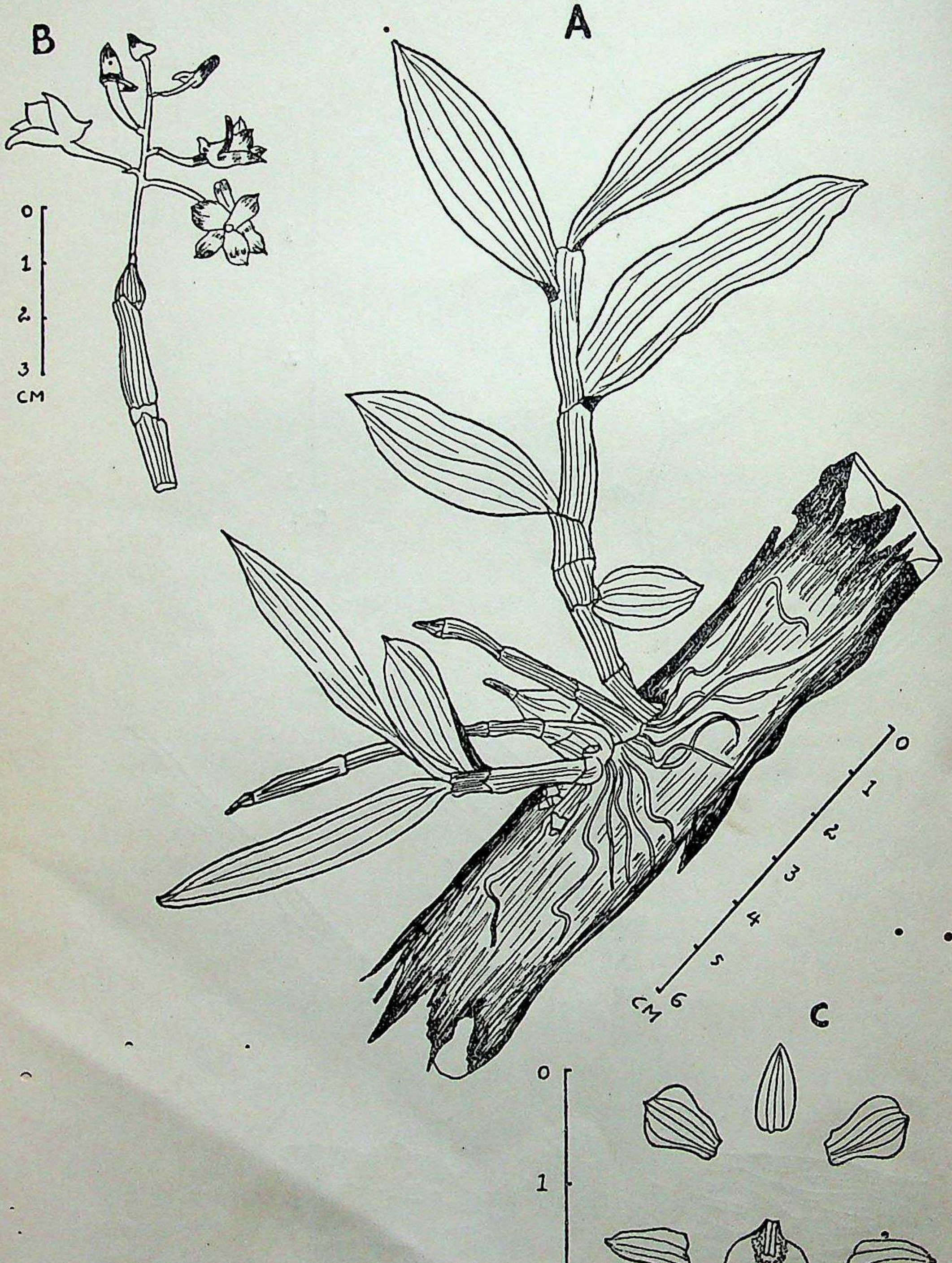
Distribution : Konkan, W. Ghats, Deccan, N. Kanara, Nilgiris, Anamalais.

5. **Dendrobium mabelae** Gammie in Journ. Bombay nat. Hist. Soc. 16 : 567, 1905 ; Cooke 681 ; Kränzl. 80 ; Blatt. & McC. 262. (See Plate XX)

Perennial, erect *epiphytes*. *Pseudobulbs* 1-4 × 0.7-2 cm., yellowish green, ovoid-conical, 1-4-noded, clothed with membranous sheaths, which on drying leave a network of fibres. *Leaves* 2-4, alternate, distichous, subcoriaceous, sessile, sheathing at the base and forming a short pseudostem above the pseudobulb, 3-8 × 0.4-0.8 cm., oblong or oblong-lanceolate, obtuse, entire, glabrous. *Inflorescence* 1-3 per plant, 5-12 cm. long. *Peduncle* slender, green, terete, straight or zigzag above, with 1-3 membranous, convolute, oblong, acute bracts. *Flowers* 1.5 × 1 cm., brown or brownish green, convolute, membranous, oblong, acute, entire, often serrulate above, glabrous, 1-nerved. *Pedicel* with *ovary* 8 mm. long, greenish white, slender, curved. *Sepals* subequal, white, entire, mucronulate, glabrous, 3-nerved, 8 × 3 mm. ; dorsal sepal broad, oblong-lanceolate ; lateral sepals 6 mm. ; broad at the base, spreading, sub-falcate, adnate along the foot, partially enclosing the lip to form an obovate, obtuse or subretuse, somewhat curved, 5 mm. long mentum. *Petals* 8 × 2.5 mm., white, linear-spathulate, mucronulate, glabrous, faintly 3-nerved. *Lip* 9 mm. long, obovate-suborbicular in outline, shallowly 3-lobed, curved ; lateral lobes 1 mm. long, white with faint, brownish red veins on the inside, or narrow, obtuse ; midlobe 3 × 6 mm. yellowish green or pure pale yellow, orbicular, emarginate, fringed with 2 rows of irregularly arranged, greenish white or yellow thick hairs ; disc yellowish green, extending as far as or a little beyond the lateral



Dendrobium mabelae Gammie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Dendrobium ovatum Kränzl.
A, Leafy plant ; B. Flowering plant ; C. Perianth segments.

lobes, with a free channelled bilobed ridge. *Column* 2 × 2 mm., greenish white ; foot 5 × 2 mm., obovate, obtuse or subretuse, yellowish on the outside, greenish white on the inside with pale red-brown short streaks. *Anther* 2-celled, yellowish green, oblong-orbicular, mobile on a thin process given out from the middle of the distal margin of the clinandrium ; pollinia 4, waxy, yellow, in pairs, oblong. *Stigmatic surface* pale-green, round, slightly broader than long. *Capsules* 2.5 × 0.7 cm., stalked, ovoid, ribbed ; pedicels 5 mm. long.

Leaves : June to October. *Flowering* : July to September, December. *Fruiting* : October to April.

Occurrence in Bombay State : W. GHATS : Igatpuri, *Kapadia* 1388 ; Panchgani, *Kapadia* 2046 ; Mahableshwar, *Santapau* 13165, 13227 ; *J. Fernandez* ; *Kapadia* 597-598, 995, 1938, 2062. N. KANARA : Belgaum Ghats, *Gammie* ; Londa, *Bhiva* ; Tinai Ghat, *Sedgwick* ; *Gammie* ; Anmod, *Sedgwick* 3370 ; *Kapadia* 1871, 1907 ; Castle Rock, *Bhiva* ; *Gammie* ; *Sedgwick* ; *Santapau* 17606 ; *Kapadia* 2800-2802.

Distribution : W. Ghats, N. Kanara, apparently endemic.

Notes : There seem to be 2 distinct forms. All the plants of the northern region of the W. Ghats (Igatpuri, Panchgani and Mahableshwar) begin to flower by the end of July and continue till September ; in the southern parts of the State (Castle Rock, Anmod) flowers do not appear till about the third week of December. Flowers of N. Kanara plants are slightly smaller, appearing without the leaves, and are pure white with a yellow lip. Except for these, we find no other differences in the flower structure to keep them apart.

6. **Dendrobium ovatum** (Willd.) Kränzl. in Pflanzenr. 45 : 71, 1910 ; Fischer 1416 ; Blatt. & McC. 262. *Cymbidium ovatum* Willd. Sp. Pl. 4 : 101, 1805 ; Graham, Cat. Bomb. Pl. 203, 1839. *Dendrobium chlorops* Lindl. in Bot. Reg. misc. 44, 1844 ; Dalz. & Gibs. 261 ; Bot. Mag. t. 5918, 1871 ; Hook. f. 719 ; Gammie 568, t. 1, 1905 ; Cooke 682. *D. barbatulum* Wight, Icon. 3 (2) : 10, t. 910, 1844-1845 (non Lindl. 1830). (See Plate XXI)

Pseudobulbs up to 50 cm. long, more or less uniformly mauve-brown, leafless at the time of flowering ; internodes one to many, 2-3.5 cm. long, longitudinally ribbed, the nodes slightly swollen. *Leaves* caducous, alternate, membranous, sheathing at the base, 5-11 × 1.2-3 cm., elliptic-oblong or oblong-lanceolate, acute, entire, glabrous, many-nerved. *Inflorescence* in racemes from the apical part of the pseudobulb, often up to 9, coming into flower at intervals ; peduncles with sheathing bracts at the base ; racemes about 3-15 cm. long, several-flowered, subpendulous. *Flowers* about 1.4-1.8 cm. across, cream-yellow (or pale nankin-coloured, according to Lindley) with pale green centres, pedicellate, bracteate. *Bracts* 2-3 mm. long, membranous, scarious, oblong, acute, sheathing. *Pedicel* with *ovary* about 17 mm. long, pale brown. *Sepals* 7-10 × 3-4 mm., pale creamy yellow, ovate-oblong, obtuse or mucronulate, entire, spreading, faintly 3-nerved, glabrous; dorsal sepal more tapered towards the apex; mentum 3-4 mm. long, pale green, more or less keel-shaped. *Petals* 7-9 × 5-6 mm. pale creamy yellow, obovate-oblong, suddenly widened just behind the minutely mucronulate apex, faintly 5-nerved, entire, glabrous. *Lip* 7-8 mm. long, pale creamy yellow, slightly clawed at the base, 3-lobed; lateral lobes 4 × 2 mm. oblong, obtuse, erect and connivent over the column; midlobe 4 × 3 mm., quadrate-oblong, rounded, subtruncate or subretuse at the apex, curved downwards from the lateral lobes, glabrous; disc with a callus, subretuse, surrounded all over by pale green, soft hairs. *Column* about 2-3 mm. long, with a foot which is broad, tapering downwards, somewhat conical, curved, 3-5 mm. long. *Anther* about 1.5-2 mm. long, conical, obtuse, apiculate in front, yellowish. *Stigmatic surface* obovoid. *Capsules* about 18 × 8 mm. oblong-ovoid, purple, ribbed; stalk 10 mm. long.

Leaves: June to September. *Flowering*: September to January. *Fruiting*: February to March.

Occurrence in Bombay: KONKAN: Salsette, *Hallberg*; Tulsi Lake, *McCann*; Bassein, *Ryan*; Badlapur, *Kapadia* 1952; Thana, *Bell*; *Kapadia* 1103; Tansa, *Santapau* 15399; *Kapadia* 1634; Pen-Campoli, *Gammie*; Khardi, *Ryan*; Wada range *Ryan*; Matheran, *Birdwood*. W. GHATS: Kasara, *Kapadia*, 894-896; Kasara—Igatpuri, *Kapadia* 1369; Khandala, *Blatter & Hallberg*; Mahableshwar, *Cooke*; Phonda Ghat, *Ritchie*. N. KANARA: Gundh, *Kapadia* 896; Belgaum, *Kapadia*; Ramanguli, *J. Fernandez* 2061; Gersoppa, *J. Fernandez*; Yellapur, *Kapadia* 2037-2038; Ankola Belikeri, *Kapadia* 2169-2174; Karwar, *Blatt. Herb*. 233.19.

Distribution: Konkan, W. Ghats, N. Kanara, southwards along to S. India.

Notes: We have noted this species epiphytic on: *Tectona grandis* L. f., *Salmalia malabarica* Sch. & Endl., *Erythrina suberosa* Roxb., *Areca* trees in a plantation in N. Kanara, *Mangifera indica* L. It is usually found in open deciduous forests.

7. **Dendrobium barbatulum** Lindl. Gen. Sp. Orch. 84, 1830; Dalz. & Gibs. 261; Bot. Mag. t. 5918 (non t. 5444); Hook. f. 719; Gammie 17: 31, t. 2. 1906; Cooke 682; Fischer 1416; Blatt. & McC. 262. (See Plate XXII)

Pseudobulbs 1.5-32 cm. long, leafless at the time of flowering, one- to several-noded, tapering at the apex; nodes 1.5-2.5 cm. long, purplish brown, about 0.5-1 cm. thick with longitudinal whitish striations. *Leaves* 4.5-13 × 1.5-3.5 cm., alternate, distichous, sheathing at the base, lanceolate to ovate-lanceolate, acute, entire. *Inflorescence* terminal or lateral; racemes 1-27-flowered, up to 25 cm. in length, erect; peduncles 1.5-8 cm. long, pale greenish brown, slender, about 1 mm. in diam., sheathed with pale brown membranous sheaths at the base. *Flowers* 2.5-4 × 2.5-4.5 cm., pedicellate, pure white, to white deeply flushed with pink-lilac. *Bracts* 3 × 1.5 mm., broadly ovate, subacuminate, pale brown, scarious, 3-5-nerved. *Pedicel* with *ovary* 1.8 cm. long, pale yellowish, somewhat pink flushed. *Sepals* and *petals* white, or white flushed with pink-lilac, spreading, somewhat recurved, acute, entire; dorsal sepal 1.5-2.6 × 0.3-0.6 cm. oblong-lanceolate to ovate-lanceolate, 3-5-nerved; lateral ones 1.7-2.7 × 0.4-0.6 cm., oblong-lanceolate, 3-5-nerved, prolonged downwards at the base to form the mentum; mentum 0.8-1 × 0.5 cm., broadly conical, obtuse, pale yellow, straight or slightly incurved. *Petals* 1.6-2.7 × 0.6-1.3 cm., obovate-lanceolate to oblanceolate, acute, tapering to the base, entire, 3-nerved. *Lip* 1.9-3 cm. long, 3-lobed; lateral lobes 7-14 × 2.5-4 mm., more or less connivent upwards to enclose the column in a somewhat cylindrical, 9-15 mm. long tube-like structure, obliquely ovate-oblong, subacute, pale creamy yellow, rarely tinged with green to deep pink flushed with mauve, with red-brown veins on the inside; midlobe 1.3-2 × 0.8-1.7 cm., white, or white flushed with pink-lilac with several deeper-coloured veins, broadly ovate or ovate-oblong or subflabellate, acute, mucronulate or rounded-obtuse, entire. *Disc* on the lip creamy, grooved, obtuse or subemarginate, with yellow hairs at its base and apex. *Column* 3 × 2 mm., stout, short, lateral arms shortly toothed; clinandrium prolonged into a small outgrowth from the back wall; foot 6-8 × 3-4 mm., obovate, broadly hollowed with a small, 3-4 mm. long, pouch-like nectary. *Anther* 1.5 × 1.5 mm., ovate-oblong, pale yellow; pollinia 2 pairs, waxy, yellowish green, linear. *Stigmatic surface* broadly obovate-orbicular, creamy white. *Capsules* 2.2 × 1.2 cm., elliptic, pedicels 11 mm. long, somewhat curved, subclavate and with a broad beak 5 mm. long; capsule greenish purple with 3 broad and 3 narrow bands.

Leaves: June to October. *Flowering*: January to May. *Fruiting*: March to July.

Occurrence in Bombay State: DANGS: Ahwa, *Kapadia* 1596-1599. KHANDESH: *Hallberg*. KONKAN: *Stocks*; *Law*; Thana, *Bell*; *Kanitkar*; Kanheri Caves, *McCann*; Chiplun, *McCann*; Ratnagiri, *Kanitkar*. W. GHATS: Kasara, *McCann*; Igatpuri, *McCann*; Khandala, *Hallberg*; *Blatter*; *McCann*; *Santapau* 233.6, 233.29, 838, 1675-1676, 2223, 3613-3614, 4362, 4878, 6124, 8644-8645, 8768, 8788, 9179, 9965, 10787, 10951, 12261; *Herbert*; *Kapadia* 493, 511, 1063, 1091, 1093, 1176-1177, 1836-1842, 1942, 2317, Lonavla, *D. K. Patel*; *McCann*; *Kapadia*; Panchgani, *J. Fernandez*; *McCann*; Panchgani-Mahableshwar, *Blatter & Hallberg*; Mahableshwar, *Cooke*; *Ezekiel* 30321; *Acland* 1175; *Santapau* 12482; *Kapadia* 1919-1922, 2058-2059. DECCAN: Purandhar, *Santapau* 11457; Dapoli, *Acland* 1176; *Kanitkar*; Bhimashankar, *Kapadia* 1448; Radhanagar, Kolhapur, *Acland*. 1174; Koina nagar, Koina Valley, *Kapadia* 2878-2879. N. KANARA: Tinai Ghat, *Sedgwick*; Anmod, *Kapadia* 1876; Castle Rock, *Kapadia* 2773, 2794-2795, 2828-2829, 2878-2879, 2937.

Distribution: Dangs, Khandesh, Konkan, W. Ghats of Bombay State and S. India, Deccan, N. Kanara, Travancore.

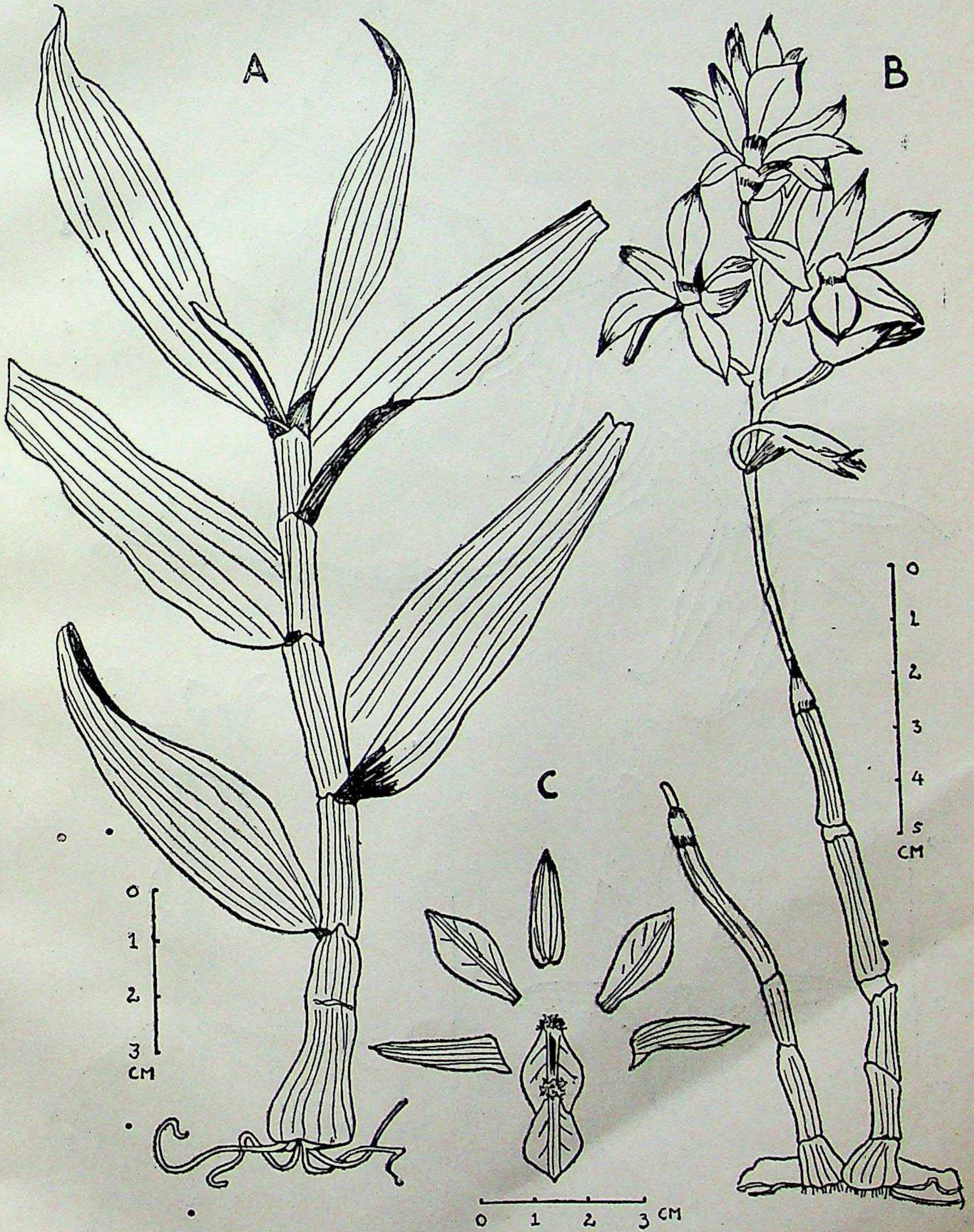
Notes: This species is epiphytic on a number of different trees and shrubs: *Terminalia* sp., *Syzygium* sp., *Heterophragma quadriloculare* Schum., *Carissa congesta* Wt., *Hymenodictyon* sp., *Sapium insigne* Benth., *Mangifera indica* L., *Salmalia malabarica* Sch. & Endl., *Vitex negundo* L., *Tectona grandis* L. f., *Ixora brachiata* Roxb., etc.

Some of the localities where this orchid is common and abundant are: Khandala, Mahableshwar and Koina nagar.

It may be of interest to point out that Rolfe (in *Gard. Chron.* 11: 298, 1892) described *Dendrobium barbatulochlorops*, a natural hybrid between *D. barbatulum* Lindl. and *D. ovatum* Kränzl. (=*D. chlorops* Lindl.), which combines the characters of the 2 species. 'Briefly it may be described as *D. barbatulum*, a little modified in shape, with the crest and side lobes of the lip of *D. chlorops*. Good specimens from both the parent species from the same collection enable these characters to be easily traced.' (R. A. Rolfe, loc. cit.).

8. **Dendrobium macrostachyum** Lindl. Gen. Sp. Orch. 78, 1830, et in Bot. Reg. t. 1865, misc. 60, 1844; Wight, Icon. t. 1647, 1851; Hook. f. 735; Prain 1007; Gammie 17: 32, 1906; Cooke 683; Kränzl. 59; Haines 1174; Fischer 1416; Blatt. & McC. 263. *Callista macrostachya* O. Kuntze, Rev. Gen. Pl. 2: 255, 1891. *Dendrobium gamblei* King & Pantling in Journ. As. Soc. Bengal II, 66: 584, 1897; Duthie 99, t. 99 et Fl. Upp. Gang. Pl. 3: 188, 1920; Kränzl. 59. (See Plate XXIII)

Pendulous *epiphytes*. *Pseudobulbs* leafless at the time of flowering, slender, 7-50 cm. long, more or less uniform, internodes 2-2.8 cm. long, 3-5 mm. thick, slightly swollen at the nodes, purplish brown with whitish longitudinal streaks. *Leaves* alternate, distichous, somewhat coriaceous, on drying becoming membranous, pale olive green, completely and closely sheathing the node below, 2-9 × 0.3-2.5 cm., narrowly lanceolate, oblong-lanceolate to ovate-lanceolate, acute, entire, usually with 3-5 fairly prominent nerves. *Inflorescence* solitary or in cymes; at first usually 3 buds are produced in basipetal succession, indicating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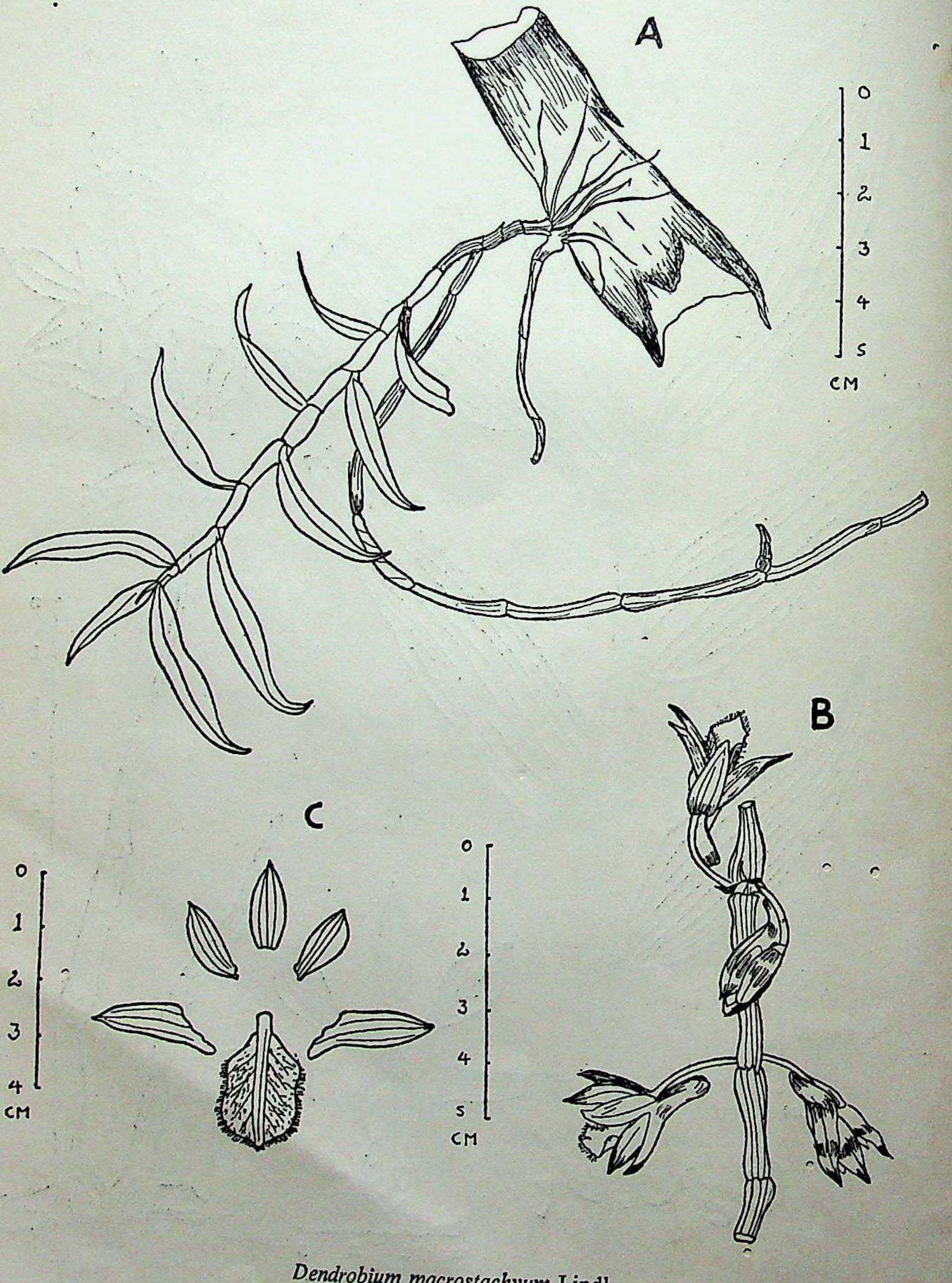
Dendrobium barbatulum Lindl.
A. Leafy plant ; B. Flowering plant ; C. Perianth segments.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Dendrobium macrostachyum Lindl.
A. Leafy plant ; B. Flowering plant ; C. Perianth segments.

a distinct dichasial cyme ; out of which generally 1 or 2, rarely all the 3, mature. *Peduncles* 2-3 mm. long, terete, thin, brown, sheathed. *Flowers* 2.5 × 2 cm., at first pale green, turning creamy yellow with age, faintly perfumed on opening, pedicellate. *Bracts* 2-3 × 1 mm., persistent, membranous, ovate, pale brown, 1-nerved. *Pedicel* with *ovary* 1.5-1.8 cm. long, curved, pale green above, tinged mauve below. *Sepals* and *petals* 1.5-1.7 × 0.6-0.8 cm., similar, not much spreading, creamy yellow, somewhat brittle, acute, entire, glabrous, faintly 5-nerved ; lateral sepals oblong-lanceolate, connivent below with the foot forming the mentum ; mentum 7 × 3-4 mm., infundibuliform, obtuse, straight or slightly curved. *Petals* obovate or oblanceolate, tapered to the base. *Lip* pale green or creamy yellow with brownish red slightly inflated nerves on the inside, obscurely 3-lobed with a 3-5 mm. long claw ; lateral lobes almost completely enveloping the column, obscure ; midlobe circular, half opening. The lip 25 × 15 mm., quadrately oblong or broadly subpanduriform in outline, only a shallow depression about the middle on the margin indicates the separation of the lateral lobes from the midlobe, obtuse ; margins minutely fimbriate, the apical half of the lip puberulous ; disc creamy yellow 3-nerved. *Column* 3 × 3 mm., greenish yellow, the lateral arms somewhat produced, acute ; foot 8 mm. long with a small nectarial depression at the base. *Anther* 2 × 2 mm., white, somewhat faintly pitted ; pollinia 4, each 1.5 × 0.5 mm. waxy, yellow, oblong. *Stigmatic surface* ovoid, pale green. *Capsules* 3.5-4 × 0.6 cm., narrowly spindle-shaped, beaked ; pedicels 1.5 cm. long.

Leaves : May to November. *Flowering* : May to June. *Fruiting* : May to December.

Occurrence in Bombay State : KONKAN : Southern parts, *Dalzell*. W. GHATS : Koina Valley, below Mahableshwar, *Cooke*. N. KANARA : Belgaum Ghats, *Gammie* ; Sampkhand, *Hallberg & McCann* 34192 ; Sirsi, *Blatt. Herb*. 34385 ; *Santapau* 18505, 18680 ; Sirsi-Siddhapur, *Kapadia* 2444 ; Siddhapur, *V. Patel* 1852 ; *Kapadia* 2375-2378 ; Jog, *Santapau* 18616 ; Bhagwati, *Kapadia* 1754-1760 ; Yellapur, *Sedgwick* ; *Bell* ; *Kapadia* 1771, 1969, 2000.

Distribution : *India* : Madhya Pradesh, Konkan, W. Ghats of Bombay State and S. India, Deccan, N. Kanara, Travancore. *World* : India, Ceylon.

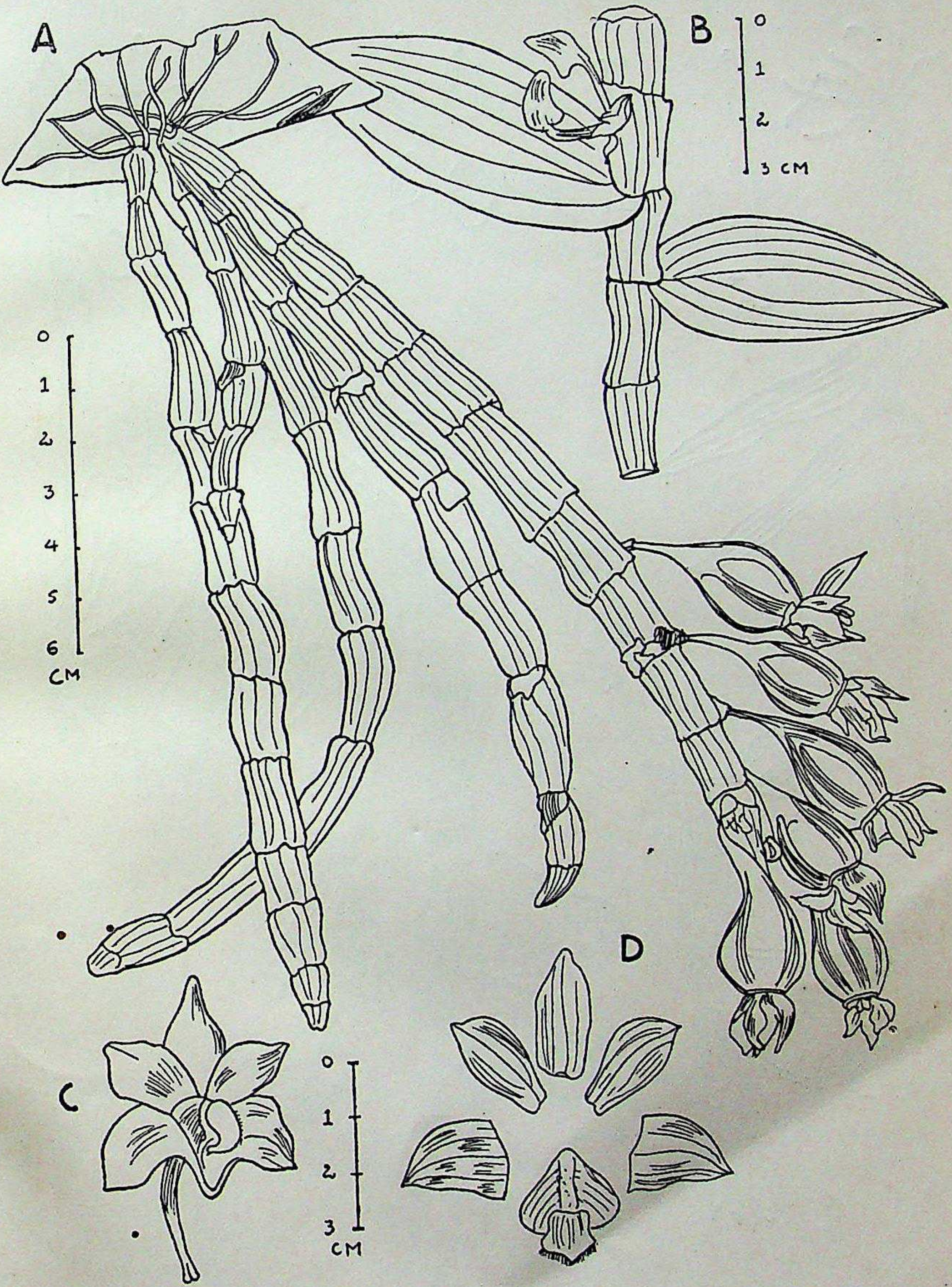
Notes : The differences between *D. gamblei* King & Pantl. and *D. macrostachyum* Lindl. seem to be slender. King & Pantling in their original description differentiate their *D. gamblei* from *D. macrostachyum* Lindl. in the following way : in the latter species " . . . the margins of the lip are slightly erose, not deeply fimbriate-serrate as in this ; the disc is naked in that, or has only a few scattered hairs ; the nectary and anther are entire in *D. macrostachyum*, and the flowers which are sweet-scented are in racemes". Duthie points out that *D. macrostachyum* differs from *D. gamblei* in the much-branched peduncles, the lip convolute at the base only and not ciliolate on the margins, and the leaves being membranous. Kränzlin distinguishes *D. gamblei* principally by the disc of the lip being villous and the margins fimbriate (not serrate).

Lindley describes *D. macrostachyum* "... floribus ternatis, racemum spurium formantibus, ... labello cucullato venoso ; limbo ovato obtuse ciliato intus pubescente". Prain describes the lip of *D. macrostachyum* Lindl. as fringed. Blatter & McCann remark from Bell's MSS notes : 'midlobe of lip embraces the whole column'. After a careful examination of abundant fresh material, we have found that the hairiness of the lip and the disc and also the degree of serration of the margin of the lip varies. Lindley himself mentions the lip of *D. macrostachyum* to be ciliate and pubescent.

From these considerations, we consider the differences between the 2 species not to be sufficient for keeping them apart. It may be pointed out that Fischer makes no mention of *D. gamblei* King & Pantl., in spite of the fact that the type locality for that species happens to be the Nilgiris. Wight's Icon no. 1647 does not seem to be very accurate.

9. **Dendrobium aqueum** Lindl. in Bot. Reg. misc. 6, t. 54, 1843 ; Hook. in Bot. Mag. t. 54, 1843 ; Hook. f. 739 ; Kränzl. 52 ; Fischer 1411 ; Blatt. & McC. 264. *D. album* Wight, Icon. 5 (1) : 6, t. 1645, 1851. *Callista aquea* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 654, 1891. (See Plate XXIV)

Pendulous, rarely erect *epiphytes*. *Pseudobulbs* 15-45 cm. long, thin at the base, gradually thickening upwards ; internodes 2-2.5 × 0.7-1.8 cm., the middle ones thickest, greyish brown, sheathed ; sheaths longitudinally striated, widening upwards. *Leaves* alternate, distichous, falling off just after flowering, 7-14 × 2-5 cm., sessile, oblong or oblong-elliptic or ovate-lanceolate, acute, entire, glabrous, 8-10-nerved. *Inflorescence* consists of fascicles of 2-3 flowers produced from the upper portion of each node along the distal half of the current season's pseudobulb. *Peduncles* hardly visible. *Bracts* 2-4, very small, membranous, imbricating at the base of the flowers, oblong or ovate-oblong, acute, entire, glabrous, translucent, 1-nerved. *Flowers* 3.5 × 2.8-3 cm., pedicellate, bracteate. *Pedicel* with *ovary* 2.7 cm. long, about 2 mm. in diameter, cylindrical, greenish white. *Sepals* white suffused with green, apiculate, entire, glabrous, 3-nerved ; lateral sepals 2 × 1.5 cm., ovate-triangular, subfalcate ; dorsal sepal 2.4 × 1.2 cm., broadly ovate. *Mentum* 11 × 6 mm., oblong, slightly funnel-shaped, obtuse. *Petals* 2.3 × 1.2 cm., spreading, white suffused with green, obovate-oblong or obovate, obtuse, slightly apiculate, entire, glabrous, 3-nerved. *Lip*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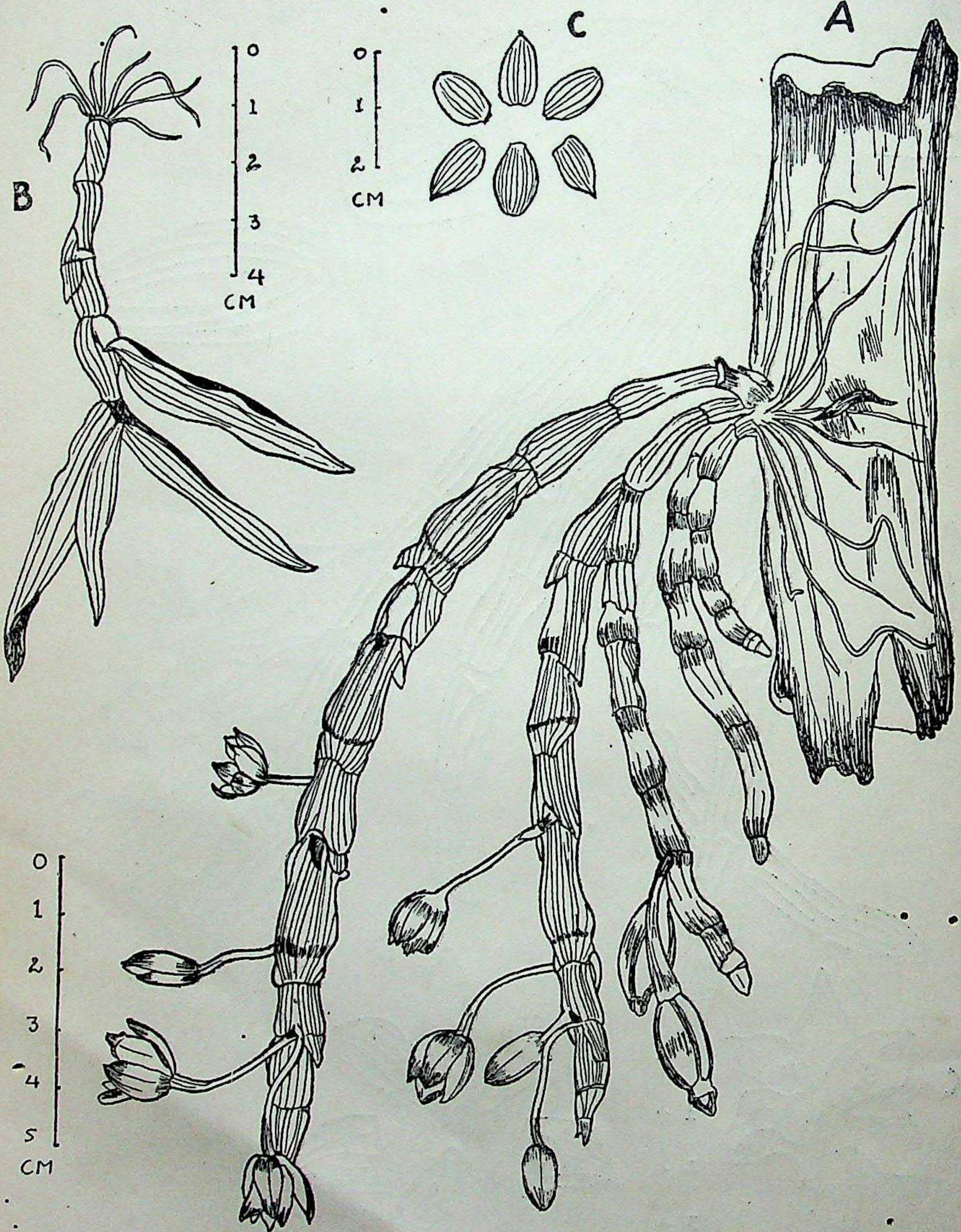
Dendrobium aqueum Lindl.
A. Fruiting plant ; B. Leafy shoot ; C. Single flower ; D. Perianth segments.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Dendrobium lawianum Lindl.
A. Flowering plant ; B. Leafy plant : C. Perianth segments.

2.2 × 2 cm., 3-lobed, whitish green, pale yellow on the inside, subrhomboid, ascending from the base to the middle, then deflexed, triangular-round in front; lateral lobes 6-7 mm. broad, obovate-oblong, rounded, entire, erect, connivent upwards, enclosing the column; midlobe 10 × 10 mm., contracted inwards at the base, oblong-cuneate, acute, ciliolate; *disc* 4 mm. broad, yellow, puberulous, extending up to the midlobe. *Column* 4-5 × 7 mm., stout, greenish white; the arms projecting upwards and forwards, partially covering the anther in front; foot 10 × 5 mm., stout, oblong, obtuse, curved, with a small, basal, pouch-like nectary. *Anther* greenish white, ovate-conical; pollinia 4, yellow, oblong, subfalcate. *Stigmatic surface* truncate, oblong, small, pale green. *Ovary* 6 × 4.5 mm., pale greenish white, ribbed. *Capsules* 4 × 1.8-2 cm., obovate-pyriform, with 6 strong ridges 2.4 mm. deep, greyish green; pedicels 1 cm. long, 2 mm. in diam., curved.

Leaves: June to October. *Flowering*: September to October. *Fruiting*: December to May.

Occurrence in Bombay: KONKAN: *Stocks* ex Kränzlin. W. GHATS: Mahableshwar, *Santapau* 12559; *Kapadia* 968, 1918, 1933-1935. DECCAN: Manched-Bhimashankar, *Kapadia* 1449.

Distribution: Konkan, W. Ghats of Bombay and S. India, Deccan.

Notes: The specific name *aqueum* refers to the pale watery green flowers.

Lindley mentions that the species is "a native of Bombay, whence it was imported by Messrs. Loddiges." Cooke and Blatter & McCann mention that the plant is often cultivated but has not been seen wild. We have found it to be fairly common at Mahableshwar.

10. **Dendrobium crepidatum** Lindl. in Paxton, Fl. Gard. 1: 63, f. 45, 1850-1851, et nov. ed. 1: 53, f. 40, 1882; Bot. Mag. tt. 4993, 5011; Hook. f. 740; Grant 78; King & Pantl. 48, t. 66; Prain 1007; Gammie 17: 33, 1906; Cooke 683; Kränzl. 39; Haines 1175; Brühl 59; Blatt. & McC. 263, f. 7. *Callista crepidata* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2: 645, 1891.

Pendulous *epiphytes*. *Pseudobulbs* greenish yellow, 8-20 cm. long, narrow at the base, thickening upwards, about 0.6-2 cm. thick; internodes about 2 cm. long, longitudinally striated, the nodes somewhat thickened. *Leaves* 4-11 × 0.5-1.5 cm., membranous, sheathing, oblong-lanceolate, acute, entire, glabrous, many-nerved. *Flowers* in pairs from the nodes of the apical parts of the pseudobulbs, pedicellate. *Bracts* minute, dry, scarious. *Pedicel* with *ovary* 23-28 mm. long, straight or slightly curved. *Sepals* about 15 × 6-7 mm., oblong, obtuse or mucronulate, fleshy, entire, 5-nerved; mentum 2-4 mm. long, shortly quadrate-rounded. *Petals* 15 × 7 mm., broadly oblong, spreading, wavy, abruptly tapered at the very base, obtuse, 5-nerved. *Lip* 17 × 11-13 mm., hardly lobed, oblong-orbicular in outline, with a narrow, 3-4 mm. long claw ; basal portion erect, more or less connivent round the column, forming a hollow at the base ; apical half spreading, wavy or slightly crimped, puberulous, rounded or shallowly emarginate at the apex. *Column* 3-4 mm. long, oblong with curved foot about 4 mm. long. *Anther* conical-oblong. *Flowers* are said to be white tipped with pink, the base of lip deep yellow.

Occurrence in Bombay State: KONKAN : *Law, Stocks* ; Vengurla, *Dalzell.* W. GHATS : Lonavla, *Gammie* ; Mahableshwar hills, *Cooke.* DECCAN : Koina nagar, Koina Valley, *Kapadia* 2872-2874.

Distribution : *India* : Sikkim, Assam, Khasia Hills, Bihar and Orissa, Deccan. Kränzlin mentions Malabar, but Fischer does not include the species in the FLORA OF THE PRESIDENCY OF MADRAS. *World* : India, Burma.

Notes : We have not been able to collect flowering specimens of this species. The details of the flowers have been studied from specimens in the Herbarium of the Botanical Survey of India (Western Circle) with the kind permission of the Regional Botanist.

Haines has taken his description from Pantling. Plants from Chota Nagpur differ in the flowers being 3.2 cm. in diam. and pink with buff at the base of the lip. This seems to be *D. lawianum* Lindl. and not *D. crepidatum* Lindl.

11. **Dendrobium lawianum** Lindl. in Journ. Linn. Soc. 3 : 10, 1859 (*lawanum*) ; Dalz. & Gibs. 261 ; Kränzl. 297. *Dendrochilum roseum* Dalz. in Hook. Kew Journ. 4 : 291, 1852. *Dendrobium crepidatum* Lindl. var. *avita* Gammie in Journ. Bombay nat. Hist. Soc. 17 : 33, 1906. *Callista lawiana* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 655, 1891. (See Plate XXV)

Pendulous *epiphytes. Pseudobulbs* 5-25 cm. long, leafless at the time of flowering, usually all curving in one direction, rarely straight, tapering at both ends ; internodes 2 cm. long, 1.2 cm. thick at the nodes, clavate, green ; generally completely enclosed in a scarious, many-nerved sheath which arises at a node and extends to about the middle of the next internode ; tip of the sheath about 1 cm. broad, broadly emarginate ; rarely the pseudobulbs are completely without sheaths, yellowish green. *Leaves* 4.5-10.5×0.5-1.7 cm., distichous, sessile, sheathing at the base, lanceolate or oblong-lanceolate, acute, entire, with usually 5 prominent nerves and several faint ones. *Flowers* subregular, shallowly cup-shaped, from the nodes in pairs or solitary ; mentum absent. *Pedicel* with *ovary* 2.5-3.5 cm. long, white flushed with pink-purple near the flower, terete. *Bracts* minute, 2-5 mm. long, pale brownish, scarious. *Sepals* and *petals* waxy, white flushed with rose-purple towards the apex. *Sepals* 12-15 × 6-8 mm., broadly oblong, subobtuse, mucronate, the margins meeting a little above the apex, entire, faintly 5-nerved. *Petals* 12-15 × 6.5-10 mm., broadly ovate-oblong, entire, obtuse or slightly retuse, faintly 5-nerved. *Lip* 12-17 × 8-10 mm., broadly ovate-oblong, broader than the petals, obtuse or retuse, slightly clawed at the base, waxy, similar in coloration to the sepals and petals, the rose-purple flush somewhat deeper. *Column* 2.25 × 2.5 mm., stout, white with 2 purple or white processes at the base, behind which there is a deep cavity (probably a nectary) ; the sides with 2 minute purple or white horns ; clinandrium broad-quadrate, the back margin with a central, 1 mm. long, apiculum to which the anther is attached. *Stigmatic surface* quadrate just below the clinandrium, glutinous, generally self-pollinated. *Anther* 3 × 2.5 mm., oblong, suborbicular, flat on top with a central transverse band, 2-celled, white flushed with rose-purple ; *pollinia* 2 pairs, 1.5 mm. long, waxy, golden-yellow, without caudicle or glandular-viscid appendage. *Capsules* 2 × 1 cm., ovoid, pale-green, ribbed, surmounted by the hardened pale brown column, pedicellate ; pedicels 2.5-3 cm. long, clavate, green.

Leaves : May to October. *Flowering* : March. *Fruiting* : April onwards.

Occurrence in Bombay State : KONKAN : *Law* ; Bombay, cultivated, *Kapadia* 1389. W. GHATS : Sahyadree Hills *Dalzell.* N. KANARA : Yellapur, *Kapadia* 1988 ; Kumbelli Mines, about 17 miles from Supa, *Kapadia* 2579-2580, 2725-2726 ; Castle Rock, *McCann* 13768 ; *Kapadia* 2834, 2843-2850 ; Anmod, *Sedgwick* 3319 ; *Kapadia* 1868, 1892-1895 ; Siddhapur, *V. Patel* 1851 ; *Kapadia* 2370-2371 ; Jog, *Santapau* 18603 ; *Kapadia* 1846 (coll. *Pirson*).

Distribution : Chota Nagpur (?), Konkan, W. Ghats, N. Kanara.

Notes : We have collected abundant fresh material from the type locality (Castle Rock) of *D. actinomorphum* Blatt. & Hallb. and from other places in N. Kanara. The type specimen of *D. actinomorphum* (*McCann* 13768) is preserved in formalin in St. Xavier's College, and has been available for study. We have come to the conclusion that *D. actinomorphum* Blatt. & Hallb. and *D. lawianum* Lindl. are identical and that this species is quite distinct from *D. crepidatum* Lindl. though externally somewhat similar. It has been included under the latter species by most authors. Kränzlin has included *D. lawianum* Lindl. as a synonym of *D. crepidatum* Lindl. on page 39 ; but then, he also describes *D. lawianum* Lindl. as a distinct species under the heading '*Dendrobia adhuc solummodo in statu pelorioïdeo nota*' on page 297.

This species is quite common all over N. Kanara and may have been easily mistaken for *D. crepidatum* Lindl., from which it can be easily distinguished by the lip, which is similar to the sepals and petals with no trace of pubescence and by the yellow coloration at the base of the lip ; the column is also characteristic in shape and is without a foot. *D. lawianum* Lindl. does not seem to be a mere accidental variation, for it is found to be distributed all over N. Kanara, and may probably occur in Chota Nagpur. The characteristic structure of the column at once distinguishes it from all other *Dendrobia* ; but absence of foot and mentum, with the almost regular flowers throws considerable doubt as to the correctness of including it in *Dendrobium*. Its general habit, however, is that of a normal *Dendrobium* and we think it best to retain it in the genus, though in an independent section.

The earlier specific epithet *roseum* of Dalzell cannot be used for this species on account of *D. roseum* Sw. (1805).

Analysis of the Proteins of Egg-white as an aid to the Classification of Birds

BY

D. B. PEAKALL, M.SC., PH.D., M.B.O.U.

(*With one text-figure*)

Proteins are complex organic compounds and are present in all living things. Their importance is indicated by the fact that both enzymes and genes are proteins. Proteins are also found in muscle, feathers, internal organs, etc., and form the principal components of blood. There are a vast number of different proteins and every species has a different protein structure. The differences and similarities are exploited in the use of protein analysis for classification.

In order to see the use of protein analysis as an aid to classification in perspective it is perhaps worthwhile to consider briefly the ideas and difficulties of classification. Classification is an attempt to map out evolutionary history. Unfortunately the fossil record of avian history is very poor. The major evolution of birds occurred in the Cretaceous period, and virtually no avian fossils have been found belonging to this period. There are the early fossil birds, the Archaeopteryx, which show that different parts evolve at different rates since the feathers were avian but the rest largely reptilian (de Beer, 1954). But, in general, fossil records have been of little aid in classification.

The Darwinian concept was that evolution proceeded from the lower to the higher, that is to say from the simpler to the more complex. It is now considered that this rule is not invariable, in any case it is difficult to know what is primitive and what is advanced. Many, one might almost say all, taxonomic characters have been used. It is difficult to know which characters are of major importance, that is, have generic value, and which are easily modified by external conditions. This is one of the great difficulties of classification, to distinguish between those characters which are similar because of recent descent from a common ancestor and those which are similar because of changes caused by adaptation to a common environment, even though they have had a quite distinct evolutionary history. For a fuller account of these problems the reader is referred to a recent review by Mayr (1959).

Besides what we may call classical methods, several others have been suggested. All have some value, and all their limitations. The study of parasites has been suggested (Clay, 1951). Parasites evolve together with their hosts and, being simpler animals, may have changed less. However, transfer is possible (Mayr, 1957) and the method must be used with caution.

Behaviour is being used to an increasing extent in the study of evolution (Lorenz, 1958; Cullen, 1959; Tinbergen, 1959). It seems that behaviour characters are as conservative as taxonomic charcters, although care must be taken to distinguish between true differences in behaviour and those caused by the local environment.

The relationship of protein analysis to classification has been known for some time. Nuttall (1901) used the analysis of blood serum to examine the zoological classification of many animals. These early investigations, although interesting, were too crude to give any significant results. There have been more recent investigations, but serology has not been widely used in avian systematics. Immunological studies show that each species has its specific antigens[1]. The studies of Irwin and co-workers [for example Irwin (1953)] have given information on the classification of the doves (Columbidae).

The most convenient source of proteins is egg-white, which consists mainly of water and proteins. The specific nature of the proteins in egg-white was first shown by immunological studies (Landsteiner & van der Scheer, 1940), but the use of electrophoresis has given a more convenient and reliable method. This method was first used in classification studies by McCabe & Deutsch (1952) and since then Sibley, using a much improved apparatus, has obtained greater accuracy and has examined the electrophoretic pattern of a large number of species. Sibley (1960) gives a full account of this work and considers in detail the validity of this method and the results obtained to date.

The formidable-looking word electrophoresis (from Gr. *phoros* to bear, *electro* by electricity) is to bear or carry something by electricity. In more scientific terms it is the transportation of charged bodies in an electrical field. Thus, if proteins are placed in an electrical field they will migrate because they have an electrical charge. Because of the different size of the molecules and the differing electrical charge, different proteins move at different speeds and thus a separation is achieved. The usual method is to place a few drops of protein on a strip of wet filter paper, across which an electrical field is placed. This field is of high voltage but of low current. After the proteins have been under the influence of this field for some hours, the strip of paper is dried and then dyed. This dye reacts with the protein to give a coloured compound which enables the position of the colourless proteins to be seen. The amount of protein present in the various bands can be determined by the optical density, the blackness, of the paper strip. Machines are available that translate the optical density of paper into a curve of optical density plotted against the distance that the protein has been moved by the electrical field.

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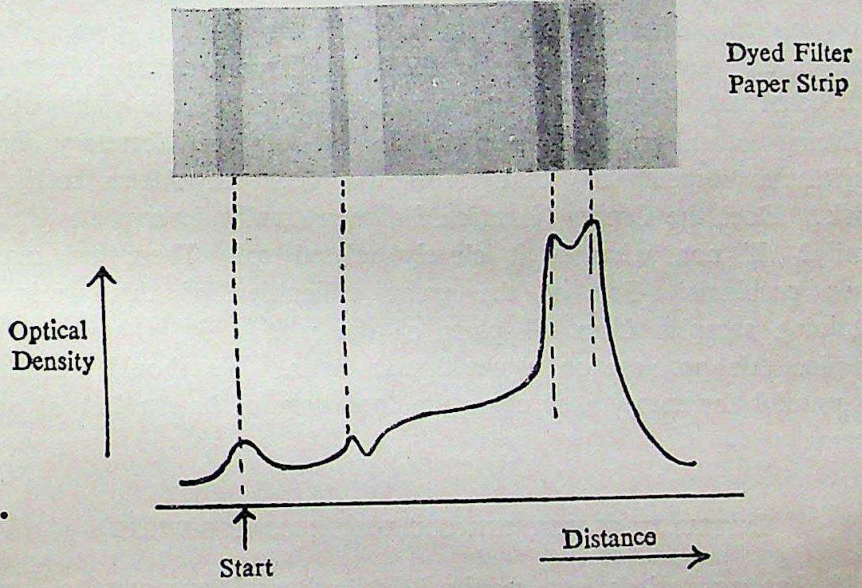
[1] **Substances which stimulate the formation of antibodies.—Eds.**

The figure below shows a drawing of a dyed filter paper strip and the optical density curve obtained from it. The curve shown above was obtained by Spofford and is of a Redtailed Buzzard (*Buteo jamaicensis*) which is found in North America and is similar to the Desert Buzzard (*B. desertorum*). It is in the classification of the hawks that we are especially interested. We should be most grateful for any egg-white specimens of this family.



The use of protein analysis in determining the classification of birds can best be shown by a few examples.

One interesting problem in classification is posed by the flamingos (Phoenicopteridae). Are these spectacular birds related to the ducks (Anatidae) as their webbed feet, bill structure, and swimming habits suggest but have evolved long legs, or are they more closely related to the storks (Ciconiidae) but have evolved some duck-like characters because of their environment? The analysis of egg-white protein supports the view that the flamingos are more closely related to the storks than to the ducks.

Another case that illustrates the fact that protein structure changes only slowly is in the Brown Hawk of Australia. Apparently, because there are no true buzzards in Australia, this species has altered its feeding habits from those of a typical falcon and now resembles those of the slow-moving buzzard. The species has been considered by some to belong to the true falcons and has been called *Falco berigora*, whilst others have placed it in a separate genus and named it *Ieracidae berigora*. When I first saw this species, in Tasmania, I thought that it was a buzzard both by stance and hunting, although the wings were more pointed than in the buzzards. The analysis of the egg-white proteins indicates that the Brown Hawk is very closely related to the five other species of the *Falco* that have been examined. Thus the separate genus for this species is probably not justified. This example shows that the protein composition changes only slowly; here more slowly than some external features. This conservative nature of proteins increases their value in systematics.

Many other problems remain. Is the strange Secretary Bird (*Sagittarius serpentarius*) that stalks the plains of Africa really a hawk? Does the Osprey (*Pandion haliaetus*) really deserve a separate family? If not, what is it closely related to? There are many other problems. One of the great difficulties of this work is obtaining samples from all parts of the world. It is essential to examine this problem on a world-wide basis. We should therefore be grateful for samples of egg-white, not only of hawks but of any species.

INSTRUCTIONS FOR THE COLLECTION OF EGG-WHITE

If the egg-shell is not required for oological purposes, a large piece of the shell is removed and the egg-white can be tipped into a small container. It is important that the egg-white is not contaminated with yolk. If the egg shell is required for an oological collection the shell is drilled as usual. While blowing the egg the contents are collected in small portions and those contaminated with yolk are thrown away, the rest put into the collecting vessel.

Egg-white has only a limited life at normal temperatures and it is necessary either to keep the samples refrigerated or to send them off within a few days. It is requested that the samples are sent airmail; postage will be refunded.

It is possible to make a satisfactory analysis on a small sample, i.e. the contents of one small egg. However if the species is abundant, it is useful to have the contents of several eggs, as a more detailed analysis can then be made.

The egg-white can be sent in any clean, convenient vessel, but anyone who thinks that he may be able to help is asked to write to Dr. Walter Spofford, Upstate Medical Center, 766 Irving Avenue, Syracuse, 10, New York, U.S.A., and a collecting kit will be sent.[1]

It is important that the eggs are identified with certainty, and that every sample is clearly labelled.

SUMMARY

Protein analysis is considered to be a useful addition to the characters used in determining the classification of birds. The method of analysis is briefly described and some account is given of the results already obtained. It is hoped that members of the Society will aid this work by sending in specimens of egg-white protein. Details of how this should be done are given at the end of the article.

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[1] Some kit has already been received by the Bombay Natural History Society and the Honorary Secretary will be glad to distribute it among those interested.—EDS.

The Birds of Nepal

PART 2

BY

BISWAMOY BISWAS

Zoological Survey of India, Indian Museum, Calcutta

[*Continued from Vol.* **57** (2):308]

Order GRUIFORMES

Family GRUIDAE

*133. **Grus grus lilfordi** Sharpe. Common Crane.

The Common Crane was not found by us in Nepal. Hodgson's earlier collection did not contain any specimen (Gray & Gray, 1846), but his later collection presented to the British Museum after he left Nepal had this species included (Gray, 1863, p. 71). Sharpe (1894, p. 254) listed four Hodgson specimens from Nepal. Scully (1879, p. 352) observed it in the central tarai and dun in winter, and noted that it passed over the Nepal Valley on migration without alighting there. Ripley (1950b, p. 368) saw it in the western lowlands in winter. Rand & Fleming (1957, p. 64) made a doubtful sight record.

*134. **Grus antigone antigone** (Linnaeus). Sarus Crane.

We did not find the Sarus Crane in Nepal. It was not included in Hodgson's first lot of specimens (Gray & Gray, 1846), but was mentioned in his later collection (Gray, 1863, p. 71). Sharpe (1894, p. 264) listed a single Hodgson skin. Scully (1879, p. 352) found it common in the central tarai. Ripley (1950b, p. 368) and Rand & Fleming (1957, p. 64) met with it in the western lowlands in winter.

*135. **Anthropoïdes virgo** (Linnaeus). Demoiselle Crane.

We were unable to find the Demoiselle Crane in Nepal. Scully (1879, p. 352) observed that it was common in the central tarai and dun in winter, and that it passed over the Valley on migration, occasionally alighting there for a short while. Ripley (1950b, p. 368) found it as a visitor in the Valley in mid-winter and early spring. Rand & Fleming (1957, p. 64) made a doubtful sight record.

Family Otididae

*136. **Ardeotis nigriceps** (Vigors). Great Indian Bustard.

The Great Indian Bustard has been recorded from Nepal only through Hodgson's specimen (Gray & Gray, 1846, p. 130), which was not, however, included in Sharpe's (1894, pp. 327-328) list.

*137. **Eupodotis bengalensis bengalensis** (Gmelin). Bengal Florican.

*138. **Eupodotis indica** (J. F. Miller). Likh or Lesser Florican.

Both the floricans are known from Nepal only through Hodgson's specimens (Gray & Gray, 1846, p. 130).

Family Rallidae

*139. **Rallus eurizonoïdes amauroptera** (Jerdon). Banded Crake.

Hodgson's collection (Gray & Gray, 1846, p. 143) appears to provide the only record of the occurrence of the Banded Crake in Nepal.

*140. **Porzana pusilla pusilla** (Pallas). Baillon's Crake.

The last record of Baillon's Crake from Nepal seems to be Scully's (1879, pp. 358-359) who found it in the Valley from July to December.

*141. **Porzana fusca bakeri** Hartert. Ruddy Crake.

There does not appear to be any post-Hodgsonian record of the Ruddy Crake from Nepal.

*142. **Porzana bicolor** Walden. Elwes's Crake.

Sharpe (1894, p. 114) listed one of Hodgson's specimens under this species, and that forms its sole record from Nepal.

143. **Amaurornis akool akool** (Sykes). Brown Crake.

Dun : Hitaura : 1 ♂ (June 7).

The single specimen of the Brown Crake was obtained from a small stream in a dense patch of forest at Hitaura.

It was not included in the earlier catalogue of Hodgson's collection (Gray & Gray, 1846), but the later one (Gray, 1863, p. 75) mentioned it from Nepal (one specimen, see also Sharpe, 1894, p. 156). Neither Scully (1879), nor Ripley (1950b) reported it thence, though Rand & Fleming (1957, p. 64) occasionally found it in the duns and lowlands.

My specimen is in worn plumage.

Measurements : 1 ♂ : Wing 125+; tail 56+; bill 33.

144. **Amaurornis phoenicurus chinensis** (Boddaert). Chinese White-breasted Waterhen.

Bhabar : Amlekhganj : 1 ♂, 1 ♀ (March 9, May 12). Dun : Hitaura : 3 ♂♂, 1♀ (May 12-30, June 23).

The Whitebreasted Waterhen is not an uncommon bird in the central bhabar and dun on rivers, particularly in dense reed-beds.

Neither Scully (1879) nor Ripley (1950b) recorded it from Nepal.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	167, 169, 171, 177	72, 74, 75 (2)	40, 42, 42.5, —
2 ♀♀ :	154, 157	66, 67	35, 36

The bill in this species has been measured from the posterior edge of the shield to the tip of the bill.

*145. **Gallinula chloropus indica** Blyth. Indian Moorhen.

We did not come across the Indian Moorhen, nor did Scully (1879), or Ripley (1950b). Rand & Fleming (1957, p. 64), however, found it common in the swamps of the lowlands.

*146. **Porphyrio porphyrio poliocephalus** (Latham). Purple Moorhen.

The Purple Moorhen has not been reported from Nepal after Hodgson's collection.

*147. **Fulica atra atra** Linnaeus. Coot.

Neither Ripley (1950b) nor we came across the Coot in Nepal. However, Scully (1879, p. 358) found it as a winter visitor to the Nepal Valley in small numbers ; Proud (1949, p. 718) saw it only once (a pair) in the Valley in January ; and Rand & Fleming (1957, pp. 64-65) had specimens brought for them from *c.* 915 m. and *c.* 2745 m. in west-central Nepal in November.

Family TURNICIDAE

*148. **Turnix sylvatica dussumier** (Temminck). Little Bustard-Quail.

Hodgson's collection (Gray & Gray, 1846, p. 129) furnishes the only record of the Little Bustard-Quail from Nepal.

149. **Turnix tanki tanki** Blyth. Indian Button Quail.

Turnix tanki Blyth, 1843, *J. Asiat. Soc. Beng.* **12**:180. (No locality=Bengal, based on drawing by Buchanan-Hamilton, hereby restricted to northern suburbs of Calcutta.)

DUN : Hitaura : 3 ♀♀ (May 14, 24, July 1).

The Indian Button Quail is rather scarce in central Nepal, having been met with by us only on a few occasions in scrub and in cultivated fields in the dun.

Scully (1879), Ripley (1950b), and Rand & Fleming (1957) do not include it in their lists.

Measurements : 3 ♀♀ ; Wing 85, 88 (2) ; tail 33, — (2) ; bill 14, 15 (2).

150. **Turnix suscitator plumbipes** (Hodgson). Himalayan Bustard-Quail.

BHABAR : Amlekhganj : 1 ♂ (March 9). DUN : Bhimphedi : 1 ♂ (May 10).

The Himalayan Bustard-Quail does not appear to be common in Nepal. Although Scully (1879, p. 350) recorded a single example from the Nepal Valley, subsequent workers failed to find it there. Ripley (1950b, p. 368) reported it only from the eastern tarai in winter, and Rand & Fleming (1957, p. 63) from *c.* 1065 m. in western Nepal in the same season.

Measurements : 2 ♂♂ : Wing 86, 92 ; tail 30+, 34 ; bill 14, 14.5.

Order CHARADRIIFORMES

Family JACANIDAE

*151. **Hydrophasianus chirurgus** (Scopoli). Pheasant-tailed Jaçana.

Hodgson's collection provides the only record of the Pheasant-tailed Jaçana from Nepal.

*152. **Metopidius indicus** (Latham). Bronzewinged Jaçana.

Rand & Fleming's (1957, p. 65) is the only post-Hodgsonian record of this jaçana from Nepal. They found it common throughout the tarai.

Family BURHINIDAE

153. **Burhinus oedicnemus indicus** (Salvadori). Indian Stone Plover.

BHABAR : Amlekhganj : 1 ♂ (March 9). DUN : Hitaura : 1 ♂ (May 24).

We found the Stone Plover on a few occasions on the sandy or shingle beds of the larger rivers in the bhabar and dun of central Nepal.

Scully (1879) did not record it from Nepal. Ripley (1950b, p. 369) found it in the western tarai in winter. Rand & Fleming (1957, p. 68) reported it from the central dun in April. Proud (1955, p. 72), on the other hand, came across it in the Nepal Valley once on August 28.

Measurements : 2 ♂♂ : Wing 214, 217 ; tail 110+, 112+ ; bill 42, 43.

*154. **Burhinus recurvirostris** (Cuvier). Great Stone Plover.

There has been no report of the occurrence of this stone plover in Nepal after Hodgson's (Gray & Gray, 1846, p. 131).

Family HAEMATOPODIDAE

*155. **Haematopus ostralegus osculans** Swinhoe. Eastern Oystercatcher.

The occurrence of the Oystercatcher in Nepal is known only from Hodgson's collection (Gray & Gray, 1846, p. 133).

Family CHARADRIIDAE

Subfamily CHARADRIINAE

I agree with Bock (1958, pp. 57-59) in synonymizing *Hoplopterus* Bonaparte, *Lobivanellus* G. R. Gray, *Chettusia* Bonaparte, *Lobipluvia* Bonaparte, and *Microsarcops* Sharpe with the genus *Vanellus* Brisson.

*156. **Vanellus leucurus** (Lichtenstein). Whitetailed Lapwing.

The first and only record of the occurrence of the Whitetailed Lapwing in Nepal is to be credited to Rand & Fleming (1957, p. 65) who found it on two occasions in the lowlands of western Nepal in winter.

*157. **Vanellus vanellus** (Linnaeus). Lapwing or Peewit.

Hodgson's collection provides the sole record of the occurrence of the peewit in Nepal.

158. **Vanellus indicus indicus** (Boddaert). Indian Redwattled Lapwing.

TARAI : Simra : 1 ♂ (March 6). BHABAR : Amlekhganj : 1 ♂ (March 9). DUN : Hitaura : 1 ♂, 1 juv. ♂, 2 ♀♀, 1 juv. ♀ (June 4, 23, July 15).

The Redwattled Lapwing is common on the streams, paddy fields, etc. of the central tarai, bhabar, and dun. It also occurs in small numbers in the Nepal Valley where it has been reported to be resident (Scully, 1879, p. 352 ; Proud, 1949, p. 718). Ripley (1950b, p. 368) recorded it from the tarai in winter, and Rand & Fleming (1957, p. 65) found it up to *c*. 1065 m. in winter.

The adult specimens taken in June and July are worn.

The juvenile female specimen (June 4) is very young. It has the crown with rufous edged feathers, mantle and scapulars barred with pale rufous brown, and the chin and throat white. The juvenile male (June 23) is a little larger. It is similar in coloration to the juvenile female, but has the crown dark brown.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	218, 232, 234	110, 116+, 119	37.5, 39, 40
2 ♀♀ :	221, 224	107+, 112+	38 (2)

159. **Vanellus duvaucelii** (Lesson). Indian Spurwinged Plover.

BHABAR : Amlekhganj : 2 ♂♂ (March 6, 9). DUN : Hitaura : 1 ♂, 2 ♀♀ (May 25, 26, June 19).

The Spurwinged Plover is quite a common bird in Nepal, occurring on the rivers of the bhabar and dun, especially on their shingle beds. We did not find it in the Nepal Valley, although Scully (1879, p. 352) recorded it as fairly common there during summer. Rand & Fleming (1957, pp. 65-66) noted it as common in western and west-central Nepal

9110 R 590.5 B63J V.57

from the tarai up to *c*. 915 m. in winter. Biswas (1960a) found it on the banks of Arun River, eastern Nepal, at *c*. 670 m. in June. Ripley (1950b) failed to come across it in Nepal.

My June specimen is worn.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	194, 196, 204	89, 92, 97	35, 36 (2)
2 ♀♀ :	193, 202	88, 90	33.5, —

Some authors, such as Ripley (in press)[1] prefer to treat *duvaucelii* as a subspecies of *V. spinosus*, with which I do not agree.

*160. **Vanellus malabaricus** (Boddaert). Yellow-wattled Lapwing.

The only post-Hodgsonian record of the Yellow-wattled Lapwing from Nepal is due to Proud (1949, p. 718) who occasionally found it in the Valley during monsoon.

*161. **Pluvialis squatarola** (Linnaeus). Grey Plover.

The occurrence of the Grey Plover in Nepal is based only on Hodgson's collection (Gray & Gray, 1846, p. 131).

*162. **Pluvialis dominica fulva** (Gmelin). Eastern Golden Plover.

The last record of the Golden Plover in Nepal was Scully's (1879, p. 351) who found it in the Valley on passage in September-October.

*163. **Charadrius leschenaultii leschenaultii** Lesson. Large Sand Plover.

Hodgson's collection (Gray & Gray, 1846, p. 132) furnishes the sole record of the Large Sand Plover from Nepal.

164. **Charadrius dubius jerdoni** (Legge). Jerdon's Little Ringed Plover.

NEPAL VALLEY : Thankot, Kathmandu : 2 ♂♂, 2 ♀♀ (April 12, 25).

We found the Little Ringed Plover not uncommonly in the Nepal Valley from about the beginning of April. It occurred on rivers and streams in pairs or in loose parties. Ripley (1950b) did not record it from Nepal.

A male and a female taken on April 25 had somewhat enlarged gonads. The testes measured 5×4 (right) and 7×4 (left), and the ovary, 6×6, the largest ovum being 3.25 mm. in diameter.

Colours of soft parts : Iris dark brown; eyelids bright yellow; bill black with the base of the upper mandible and the basal third of the lower mandible yellow; legs and feet dull greyish olive; claws black; pads fleshy.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	107, 109	55, 58	16, 17
2 ♀♀ :	105, 111	54, 60	16, 17

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[1] References to Ripley (in press) in parts 1 and 2 of this series and in the parts to follow are based on the galley proofs of A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN, which the author had the privilege of seeing. The text as finally published may, of course, differ from the galley proofs.

पुस्तकालय

*165. **Charadrius alexandrinus alexandrinus** Linnaeus. Kentish Plover.

Although not mentioned in either edition of catalogues of Hodgson's collections (Gray & Gray, 1846 ; Gray, 1863), three specimens of the Kentish Plover from Nepal presented by Hodgson were listed by Sharpe (1896, p. 281). Later, only Rand & Fleming (1957, p. 66) have reported it from Nepal (eastern tarai) in winter.

*166. **Charadrius placidus** J. E. & G. R. Gray. Longbilled Ringed Plover.

The last record of this plover from Nepal was by Scully (1879, p. 351) who found it as an uncommon bird in Nawakot district, central Nepal, in November.

*167. **Charadrius mongolus atrifrons** Wagler. Lesser Sand Plover.

The only Nepali record of this Sand Plover is in Hodgson's collection (Gray & Gray, 1846, p. 133).

Subfamily SCOLOPACINAE

*168. **Numenius phaeopus ? variegatus** (Scopoli). Eastern Whimbrel.

The Whimbrel has not been reported from Nepal after Hodgson's collection.

*169. **Numenius arquata orientalis** C. L. Brehm. Eastern Curlew.

The post-Hodgsonian records of the Curlew in Nepal are Scully's (1879, p. 356) who found it as a rare visitor to the Valley where Proud (1949, p. 718) observed it only once (August) ; and Biswas's (1960a) who reported hearing it on the Khumbu glacier, eastern Nepal, at *c.* 5790 m. in May.

*170. **Limosa limosa limosa** (Linnaeus). Blacktailed Godwit.

Scully's (1879, p. 356) is the only record of the Blacktailed Godwit from Nepal since Hodgson's days.

*171. **Tringa erythropus** (Pallas). Spotted or Dusky Redshank.

There seem to be only two records of this redshank from Nepal. The first one was by Hodgson (Gray & Gray, 1846, p. 139), and the last, by Ripley (1950b, p. 368) who found it between December and February both in western (Karnali river) and in eastern (Kosi river) Nepal.

*172. **Tringa totanus eurhinus** (Oberholser). Eastern Redshank.

The only post-Hodgsonian record of the Eastern Redshank is due to Rand & Fleming (1957, p. 66) who took a specimen at Pokhara (*c.* 915 m.), west-central Nepal, in December.

*173. **Tringa nebularia** (Gunnerus). Greenshank.

Scully (1879, p. 358) noted it as fairly common from September through winter in central Nepal (plains and tarai, Nawakot district, Nepal Valley). Proud (1955, p. 72) observed it common in the Nepal Valley only on autumn migration (August-September). Ripley (1950b, p. 368), and Rand & Fleming (1957, p. 66) found it in both the western and eastern lowlands in winter.

174. **Tringa ochropus** Linnaeus. Green Sandpiper.

NEPAL VALLEY : Kathmandu (Bagmati and Bishnumati rivers), Thankot : 2 ♂♂, 1 ♀, 1 unsexed (March 19, April 14, 28).

The Green Sandpiper was found by us in small numbers on the rivers of the Nepal Valley during late March and April. It would appear that its numbers had already dwindled by mid-March. By the end of April, the majority had left for the breeding quarters.

Lowndes (1955, p. 37) noted it singly on several occasions at Bagra, Marsiyandi Valley, central Nepal, in July.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	140, 145	55, 57	40, —
1 ♀ :	139	57	40
1 unsexed :	145	61	42.5

*175. **Tringa glareola** Linnaeus. Wood Sandpiper.

The post-Hodgsonian records of the Wood Sandpiper from Nepal consist of Proud's (1955, p. 72) who found it common in the Nepal Valley on passage in autumn and spring, and Rand & Fleming's (1957, p. 67) who noted it occasionally in the lowlands of both west-central and eastern Nepal during winter.

176. **Actitis hypoleucos hypoleucos** (Linnaeus). Common Sandpiper.

NEPAL VALLEY : Kathmandu, Thankot : 2 ♀♀ (April 12, 25).

The Common Sandpiper is fairly common on the rivers of the Nepal Valley in spring. It is generally found singly along the edges of water.

Ripley (1950b, p. 368) and Rand & Fleming (1957, p. 67) found it in the western and eastern lowlands in winter ; and Biswas (1960a) recorded it at *c.* 855 m. in Chautara district, central Nepal, on January 27.

My April 12 specimen has the wings in moult.

The specimen taken on April 25 had somewhat enlarged ovary, with the ova of the size of mustard seeds, the largest one being 2 mm.

Colours of soft parts : Iris dark brown ; bill greenish horny, with almost black anterior third and very pale sides of the middle part of the lower mandible ; legs and feet dull greenish grey ; claws horny ; pads dull greenish grey.

Measurements : 2 ♀♀ : Wing 116, — ; tail 54, 60 ; bill 28, 30.

177. **Gallinago solitaria solitaria** Hodgson. Solitary Snipe.

CHITLANG VALLEY : Chitlang : 1 ♀ (April 19).

This was the only specimen of the Solitary Snipe found by us in Nepal. However, Scully (1879, p. 354) noted it to be not uncommon in the Valley from October to March, and Stevens (1925c, p. 892) found it on Singalila Range, eastern Nepal, at *c.* 3050 m. in January. Neither Ripley (1950b), nor Rand & Fleming (1957) record it from Nepal.

Measurements : 1 ♀ : Wing 167; tail 72; bill 83.

*178. **Gallinago nemoricola** Hodgson. Wood Snipe.

The Wood Snipe was not found by us, or by Rand & Fleming (1957) in Nepal. Scully (1879, p. 353) noted it to be rare in the Nepal Valley, having seen it there only twice in winter. Mr. Kilbourne, as reported by Ripley (1950b, p. 368), found it in the Valley in small numbers.

*179. **Gallinago stenura** (Bonaparte). Pintail Snipe.

We did not come across the Pintail Snipe in Nepal, nor did Rand & Fleming (1957). Scully (1879, p. 354), and Proud (1949, p. 718), however, reported it on passage in the Nepal Valley where many birds stay on for the winter.

*180. **Gallinago gallinago gallinago** (Linnaeus). Fantail Snipe.

Neither Rand & Fleming (1957) nor we found this snipe in Nepal. Scully (1879, pp. 355-356) and Proud (1949, p. 718) both noted it mainly on passage in the Nepal Valley, although many birds stay on there for the winter. Scully further observed that it was much less common than the Pintail Snipe. Ripley (1950b, p. 368) reports that Mr. Kilbourne, on the other hand, found the Fantail to be the commonest of the snipes in the Valley.

*181. **Gallinago minima** (Brünnich). Jack Snipe.

We were unable to find the Jack Snipe in Nepal, neither were Rand & Fleming (1957). Scully (1879, p. 356) observed it mainly on passage in the Nepal Valley where many examples spent the winter, and in the Nawakot district in November. Proud (1949, p. 718), however, describes it as a scarce passage migrant in the Valley where a few probably spend the winter.

182. **Scolopax rusticola rusticola** Linnaeus. Woodcock.

NEPAL VALLEY : Thankot : 1 ♀ (April 6).

We found the Woodcock rather rare in central Nepal during spring and summer. This specimen was taken in a small swampy patch in the forest off Thankot.

Scully (1879, p. 353) reported that the Woodcock left the Valley at the end of February, and Proud (1949, p. 718) found it as a scarce winter visitor there. Ripley (1950b, p. 368) saw and trapped it in eastern Nepal at *c*. 2745 m. in winter. Lowndes (1955, p. 37) observed it 'roding' on May 25 at *c*. 1980 m. in the Marsiyandi Valley, central Nepal. Rand & Fleming (1957, p. 67) obtained specimens in the Nepal Valley in January, and in eastern Nepal at *c*. 2895 m. in December. Biswas (1960a) saw it 'roding' on a few occasions in Khumbu, eastern Nepal, at *c*. 3655 m. early in April.

Measurements : 1 ♀ : Wing 182 ; tail 76 ; bill —.

Resuscitation of Hodgson's name *Scolopax indicus*, 1837 (type locality Nepal) by Koelz (1954, p. 32) for the birds breeding 'throughout the Himalayas and to the east' does not seem to be justified.

183. **Calidris minutus** (Leisler). Little Stint.

NEPAL VALLEY : Kathmandu : 1 ♀ (April 25).

This solitary specimen of the Little Stint was found in a flock of Temminck's Stint on Bagmati river. It was not reported from Nepal by Scully (1879), or Ripley (1950b), or Rand & Fleming (1957).

The wings of the specimen are in moult. The outermost primaries are still growing, but the other remiges have already moulted.

The specimen had a slightly swollen ovary with finely granular ova.

Colours of soft parts : Iris dark brown ; bill dark horny with greenish tinge on base ; legs and feet very deep greenish horny ; claws horny ; pads greenish grey.

Measurements : 1 ♀ : Wing — ; tail 39 ; bill —.

Gladkov (1957, pp. 195-203) has shown that *Calidris minuta* and *C. ruficollis* are two separate species.

184. **Calidris temminckii** (Leisler). Temminck's Stint.

NEPAL VALLEY : Kathmandu : 2 ♂♂, 3 ♀♀ (March 23, April 25).

Temminck's Stint is quite common in spring on the sandy banks and islands of Bagmati river in the vicinity of Kathmandu. In March and early April it was observed in flocks of a dozen birds or so in the morning, but later in the day and in the afternoon they moved away elsewhere. During the second week of April the flocks were found to be just beginning to break up into pairs.

Ripley (1950b) did not find it in Nepal. Rand & Fleming (1957, pp. 67-68) noted it in the western and eastern lowlands in winter.

Two of my specimens (1 ♂, 1 ♀) taken on March 23, have the rectrices in moult.

The March 23 specimens had the gonads but slightly enlarged (testes 2×1.5 each, ovary 5.5×4, finely granular), and the April 25 specimens had them more enlarged, the ovaries having coarsely granular ova.

Colours of soft parts : In March : Iris dark brown; bill black with pale horny on base of the upper mandible and pale yellowish brown on base of the lower mandible; legs and feet yellowish brown; claws black; pads yellowish brown.

In April : Iris dark brown ; bill black with greenish to dark greenish horny on basal half of the upper mandible and olive on basal third of the lower mandible ; legs and feet olive to yellowish olive ; claws black ; pads olive brown.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	95.5, 97	51.5, —	18, 20
3 ♀♀ :	95, 101 (2)	49.5, 51	20, 20.5 (2)

*185. **Calidris alpinus** (Linnaeus) ? subspecies. Dunlin.

Hodgson's collection (Gray & Gray, 1846, p. 140) provides the sole record of the occurrence of the Dunlin in Nepal.

*186. **Philomachus pugnax** (Linnaeus). Ruff and Reeve.

We did not come across the Ruff and Reeve in Nepal, nor did Ripley (1950b) or Rand & Fleming (1957). Scully (1879, p. 357), and Proud (1955, p. 72) recorded this species in the Nepal Valley on passage in autumn.

Subfamily RECURVIROSTRINAE

*187. **Himantopus himantopus himantopus** (Linnaeus). Blackwinged Stilt.

*188. **Recurvirostra avosetta** Linnaeus. Avocet.

The only records of the Blackwinged Stilt and the Avocet from Nepal are based on Hodgson's collection (Gray & Gray, 1846, p. 138).

Subfamily IBIDORHYNCHINAE

*189. **Ibidorhyncha struthersii** Vigors. Ibisbill.

We did not find the Ibisbill in Nepal, nor did Scully (1879). Ripley (1950b, p. 368) observed it in the eastern tarai (Chatra) in February. Polunin (1955, p. 896) reported it from the Langtang Valley, central Nepal, from June to September. Rand & Fleming (1957, p. 68) found it at *c.* 760 m. in west-central Nepal in February. Biswas (1960a) observed it at *c.* 855 m. on Sun Kosi river at Dolalghat, Chautara district, central Nepal, in late January.

Subfamily ROSTRATULINAE

*190. **Rostratula benghalensis benghalensis** (Linnaeus). Painted Snipe.

Hodgson found it in the hills and plains of Nepal in winter (Gray & Gray, 1846, p. 140). It has not since been reported from that country.

Family GLAREOLIDAE

*191. **Cursorius coromandelicus** (Gmelin). Indian Courser.

After Hodgson's record (Gray & Gray, 1846, p. 131), the Indian Courser has been reported from Nepal only by Rand & Fleming (1957, p. 68) from the western tarai (once).

*192. **Glareola pratincola maldivarum** J. R. Forster. Large Indian Pratincole or Swallow-Plover.

The occurrence of the Large Indian Pratincole in Nepal is known only from Hodgson's collection (Gray & Gray, 1846, p. 131).

*193. **Glareola lactea** Temminck. Small Indian Pratincole or Sand Plover.

The post-Hodgsonian records of this pratincole from Nepal are Ripley's (1950b, p. 369) who saw it in the eastern tarai (Kosi river) in February, and Rand & Fleming's (1957, p. 68) who found it in the central dun at *c*. 760 m. in April.

Family LARIDAE

*194. **Larus ichthyaetus** Pallas. Great Blackheaded Gull.

The first and the only record of the Great Blackheaded Gull in Nepal has been provided by Rand & Fleming (1957, pp. 68-69) who occasionally found it along the larger rivers of the tarai in winter.

*195. **Larus brunnicephalus** Jerdon. Brownheaded Gull.

Hodgson's single specimen (Salvin, 1896, p. 218) forms the sole record of the Brownheaded Gull from Nepal.

*196. **Larus ridibundus** Linnaeus. Blackheaded Gull.

Salvin (1896, p. 215) listed a single Hodgson skin of the Blackheaded Gull from Nepal in the British Museum ; but in Gray & Gray's catalogue (1846, p. 148) of Hodgson's collection, this species was mixed up with *L. brunnicephalus*. The only other record from Nepal has been made by Rand & Fleming (1957, p. 69) who occasionally found it on the rivers of the lowlands in winter.

*197. **Sterna aurantia** J. E. Gray. Indian River Tern.

Neither Ripley (1950b), nor we came across the Indian River Tern in Nepal, but Scully (1879, p. 364) found it in the Nepal Valley on passage in early winter and early summer ; Rand & Fleming (1957, p. 69) recorded it as a common bird of the lowlands in winter ; and Biswas (1960a) found it on Arun river, eastern Nepal, at *c*. 670 m. in June.

*198. **Sterna hirundo tibetana** Saunders. Tibetan Tern.

The only record of the Tibetan Tern from Nepal has been furnished by Proud (1955, p. 72) who found it in the Nepal Valley on autumnal migration when it sometimes remained there for a day or two.

*199. **Sterna acuticauda** J. E. Gray. Blackbellied Tern.

Although the Blackbellied Tern was not listed in Gray & Gray's (1846) catalogue, a single skin from Nepal, presented by Hodgson, is included in Salvin's (1896, p. 45) catalogue. The two other records from Nepal are Rand & Fleming's (1957, p. 69) who found it fairly common in the tarai during winter, and Biswas's (1960a) who noted it on Arun and Sabhaya rivers, eastern Nepal, at *c*. 670-760 m. in June.

Order COLUMBIFORMES

Family PTEROCLIDAE

*200. **Pterocles exustus erlangeri** (Neumann). Common Sandgrouse.

*201. **Pterocles indicus indicus** (Gmelin). Painted Sandgrouse.

Both these sandgrouse are known from Nepal only through Hodgson's collection (Gray & Gray, 1846, p. 129).

*202. **Pterocles orientalis orientalis** (Linnaeus). Imperial Sandgrouse.

Hodgson's single specimen (Gray & Gray, 1846, p. 129 ; Ogilvie-Grant, 1893, p. 21), obviously a stray bird, forms the sole record of the Imperial Sandgrouse in Nepal.

Family COLUMBIDAE

203. **Treron apicauda apicauda** Blyth. Pintailed Green Pigeon.

Treron apicauda 'Hodgson' Blyth, 1845, *J. Asiat. Soc. Beng*. **14** : 854. ('Southeastern Himalaya and hill ranges of Assam, common at Darjeeling', hereby restricted to Darjiling, West Bengal.)

DUN : Hitaura : 3 ♂♂, 1 ♀, 1 juv. ♀ (May 12—June 2).

The Pintailed Green Pigeon appears rather scarce in Nepal. We found it in small numbers only in the central dun. It was observed partial to forests on hills and tall trees with dense foliage. Ours appears to be the only post-Hodgsonian record of this species from Nepal.

The juvenile female specimen has the feathers of the back with greyish centres, and its central rectrices are not so narrow as those of the adult.

Measurements :

	Wing	Tail	Rhamphotheca
3 ♂♂ :	164+, 176, 177	182, —, 184	10, 10.5 (2)
1 ♀ :	166	174+	10

The tail measurements of males as given by Baker (1928, p. 199) appear too large.

The nominate subspecies intergrades with *laotinus* in Assam (Margherita, Khasi Hills, Cachar) and north-western Burma (Chindwin, Myitkina).

204. **Treron sphenura sphenura** (Vigors). Wedgetailed Green Pigeon.

Vinago sphenura Vigors, 1831, (1832), *Proc. zool. Soc. Lond.* (1):173. (Himalayas = Darjiling, according to Baker, 1922e, p. 832.)

DUN : Hitaura, Bhimphedi : 4 ♂♂, 3♀♀ (March 13, May 5-19, June 1). CHITLANG VALLEY : Chitlang : 4♂♂, 3♀♀ (April 8-27).

The Wedgetailed Green Pigeon is a common bird of central Nepal from the Nepal Valley down to the dun. Ripley (1950b, p. 369) found it in eastern Nepal in winter, and Biswas (1960a) in summer, although Rand & Fleming (1957, p. 69) noted it to be absent in the hills of both western and eastern Nepal in winter. Lowndes (1955, p. 36) reported it to be common in Manangbhot, central Nepal, at *c.* 2440 m. in August.

Measurements :

	8 ♂♂	6 ♀♀
Wing :	176, 180, 181, 182 (2), 187, 188, —	171, 172, 173, 175, 176, 179
Tail :	126+, 129, 130 (2), 134, 135, 140, 145	124 (3), 125, 126,—
Rhamphotheca :	9.5 (2), 10 (3), 11, —(2)	9 (3), 9.5,—(2)

*205. **Treron curvirostra nipalensis** (Hodgson). Thickbilled Green Pigeon.

This green pigeon was not found in Nepal by Scully (1879) or Ripley (1950b) or by us. Polunin (1955, p. 895) obtained it in summer at *c.* 2745 m. in the Langtang Valley, central Nepal, and Rand & Fleming (1955, pp. 69-70) reported it as an uncommon bird in the central lowlands in April.

*206. **Treron pompadora conoveri** Rand & Fleming. Conover's Green Pigeon.

Rand & Fleming (1953, p. 201 ; 1957, p. 70), who discovered this race, are the first to report the occurrence of this species in Nepal. They found it in winter in flocks of 4-15 in heavy forest in the tarai of west-central Nepal.

*207. **Treron bicincta bicincta** (Jerdon). Orangebreasted Green Pigeon.

The earlier collection of Hodgson (Gray & Gray, 1846) did not contain this green pigeon, but his later collection which contained birds from Nepal as well as from other places, included this species (Gray, 1863, p. 66). The first definite Nepali record of the species is owed to Rand & Fleming (1957, p. 70) who occasionally found it in winter in the west-central lowlands.

208. **Treron phoenicoptera phoenicoptera** (Latham). Bengal Green Pigeon.

DUN : Hitaura : 7 ♂♂, 1 juv. ♂ (June 7, 16-19; July 14-29).

The Bengal Green Pigeon is common in the central dun particularly on fruit-bearing *Ficus* trees. Ripley (1950b, p. 369), and Rand & Fleming (1957, p. 70) found it in lower elevations of western and west-central Nepal, respectively.

The juvenile specimen (♂) has brown primaries.

One of my adult males (June 7) had somewhat enlarged testes, the right one measuring 11.5 × 5.5 mm., and the left, 9.5 × 6 mm.

Measurements : 7♂♂ : Wing 190, 192, 194, 196, 198, 200 (2) ; tail 112, 113, 115, 119, 120, 122 (2) ; rhamphotheca 12, 13 (2), 13+, 13.5, —(2).

[**Ducula aenea sylvatica** (Tickell). Green Imperial Pigeon.

Baker (1928, p. 208) included Nepal within the range of the Green Imperial Pigeon, presumably based on a specimen in the British Museum (ex Salvin-Godman Collection) which doubtfully came from Nepal (Salvadori, 1893, p. 193). Baker's action has, however, been followed by Peters (1937, p. 46) and Ripley (in press). Although the possibility of its occurrence in Nepal cannot be denied, I am unable to trace any authentic report to that effect.]

*209. **Ducula badia insignis** Hodgson. Imperial Pigeon.

The Imperial Pigeon has not been reported from Nepal since Hodgson's days.

*210. **Columba leuconota leuconota** Vigors. Snow Pigeon.

Neither Ripley (1950b), nor Rand & Fleming (1957) or we found the Snow Pigeon in Nepal. Scully (1879, p. 340) reported it from ' the upper northern regions of Nepal '. Smythies (1948, p. 442) found it in autumn at *c.* 4570 m. in the Gandak-Kosi watershed, central Nepal. Polunin (1955, p. 895) noted it to be quite common in summer above forest zone up to *c.* 4875 m. or more in the Langtang Valley, central Nepal. He further reported of a flock that remained all August at *c.* 3350 m. Lowndes (1955, p. 36) found it in summer to be very common between *c.* 3350 m. and 4725 m. and less common higher up in the Manangbhot area, central Nepal. Biswas (1960a) observed it at *c.* 2285-3050 m. in February and later up to April between *c.* 3655 and 4875 m. in Khumbu, eastern Nepal.

211. **Columba livia intermedia** Strickland. Indian Blue Rock Pigeon.

DUN : Hitaura : 1 ♂ (May 28). NEPAL VALLEY : Kathmandu, Thankot : 2 ♂♂, 2 ♀♀ (March 21-27).

The Blue Rock Pigeon is commonly found in flocks from the central dun up to the Nepal Valley, in and around villages and towns, as well as about cultivated fields.

Lowndes (1955, p. 36) reported it to be common in summer at *c.* 3050-3960 m. in Manangbhot, central Nepal, and Rand & Fleming (1957, pp. 70-71) at *c.* 915 m. and *c.* 2805 m. in winter in west-central Nepal.

My female specimen from Kathmandu (March 21) had granular ovary. This specimen still has some amount of juvenile plumage. There is much brown on wing coverts and breast, very little metallic purple and green, not very dark black bands on secondaries, browner primaries, and lower breast and abdomen ashy with a few brown feathers. There is no sign of moult.

The male specimen from Hitaura (May 28) has well-developed testes, measuring 14 × 7.5 mm. (right).

Measurements :

	Wing	Tail	Rhamphotheca
3 ♂♂ :	220, 221, 227	111, 114, 117	10, 10.5, 11.5
2 ♀♀ :	213, 216	102, 105	10, 10.5

*212. **Columba palumbus casiotis** (Bonaparte). Wood Pigeon.

Although Nepal falls within the range of the Wood Pigeon, it has not been included in any of the lists of Nepal birds, nor has it been observed by us. Salvadori (1893, p. 303), however, mentioned one specimen from that country, presented by Hodgson to the British Museum.

213. **Columba arquatrix hodgsonii** Vigors. Speckled Wood Pigeon.

Columba Hodgsonii Vigors, 1832, *Proc. zool. Soc. Lond.* (2):16. (Himalayas= Nepal, according to Baker, 1922e, p. 834.)

NEPAL VALLEY : Thankot : 1 ♂ (April 4).

The Speckled Wood Pigeon did not appear to be a common bird in central Nepal. A pair was seen by us once in the forest at Thankot in April, and a small flock at Godavari in May.

Scully (1879, p. 339) noted it to be a winter visitor (December to February) to the foot of the hills round the Nepal Valley where it was common at certain places. Ripley (1950b, p. 369) found it only in the Valley and only in April-May, thus corresponding with our observation. Lowndes (1955, p. 36) saw several birds in summer at *c.* 3050 m. in Manangbhot, and Proud (1955, p. 71) found it common in the Nepal Valley. Rand & Fleming (1957) did not come across it.

Measurements : 1 ♂ : Wing 228 ; tail 150 ; rhamphotheca 10.

Recently, Goodwin (1959, p. 14) suggests that *C. arquatrix* and *C. hodgsonii* should be treated as two distinct species.

214. **Columba pulchricollis** Blyth. Ashy Wood Pigeon.

DUN : Bhimphedi : 1 ♂ (May 10).

The Ashy Wood Pigeon does not appear to be a common bird in Nepal. It was seen by us only on a few occasions on the Mahabharat Range in dense forests.

Ripley (1950b, pp. 369-370) found it not uncommon in the heavily wooded parts of the Nepal Valley. He also recorded it from eastern Nepal. Proud (1955, p. 71) found it scarce in the Valley. Rand & Fleming (1957, p. 71) reported it only from the heavily wooded regions of west-central Nepal. Scully (1879) did not include it in his list.

Measurements : 1 ♂ : Wing 210 ; tail 126 ; rhamphotheca 10.

215. **Macropygia unchall tusalia** (Blyth). Bartailed Cuckoo-Dove.

DUN : Hitaura : 1 ♂ (May 15). NEPAL VALLEY : Thankot : 1 ♀ (March 26).

The Bartailed Cuckoo-Dove was found by us in small numbers in the Nepal Valley in forests at the base of the Chandragiri near Thankot, and of the Phulchauki Danda about Godavari during March-May. It was observed again in the central dun around Hitaura in May-June.

Ripley (1950b, p. 370) recorded it from the Chandragiri Pass above Thankot, and in eastern Nepal at *c.* 2440 m. Neither Scully (1879), nor Rand & Fleming (1957) found it in Nepal.

Measurements :

	Wing	Tail	Rhamphotheca
1 ♂ :	203	202	7
1 ♀ :	194	187	7

216. **Streptopelia orientalis meena** (Sykes). Western Rufous Turtle Dove.

217. **Streptopelia orientalis agricola** (Tickell). Eastern Rufous Turtle Dove.

BHABAR : Amlekhganj : 1 ♂ (March 10). DUN : Hitaura : 1 ♂, 1 juv. ♂ (June 9, 15). CHITLANG VALLEY : Chitlang, 2 ♀♀ (April 17). NEPAL VALLEY : Thankot : 6 ♂♂, 2 ♀♀ (March 20—April 4).

The Rufous Turtle Dove is a common bird in central Nepal. It is, however, not so common in the bhabar in spring and the dun in summer as it is in the Nepal Valley during March-May. It is usually found in the opener parts of forests, sometimes about villages.

Scully (1879, p. 341) found it throughout the year in the Valley where Proud (1949, p. 718), however, notes it only as a summer visitor (mid-March onwards). Lowndes (1955, p. 36) found it up to *c.* 3960 m. during summer in Manangbhot, central Nepal. In eastern Nepal, Ripley (1950b, p. 370) found it in the Arun watershed in winter from *c.* 305 to 2590 m. Biswas (1960a) recorded it in April-May between *c.* 3050 and 3960 m. in Khumbu and in June at *c.* 1525 m. in the Arun watershed. It would appear that the highest altitudinal limits of *meena* and *agricola* should be raised from the usually accepted *c.* 2745 m. (Ripley, in press) to *c.* 3960 m.

Most of my March and April specimens were breeding.

The juvenile male bird (June 15) is in very worn plumage.

Measurements :

	8 ♂♂	4 ♀♀
Wing :	180 (2), 182, 187, 188, 193, 197 (2)	185, 187, 190, 195
Tail :	122 (2), 125, 129, 135, 136, 138, 140	123, 126, 130 (2)
Rhamphotheca :	8 (4), 8.5, 9, — (2)	8, 8.5 (2), 9

From an examination of breeding examples, it appears that *S. o. meena* intergrades with *agricola* in central Nepal. One may find there all gradations from true *meena* to true *agricola*, especially with regard to the colour of the under tail coverts, contrary to Rand & Fleming's (1957, p. 71) conjecture (see also Scully, 1879, p. 341). The position, of course, is not quite so easy or clear when all birds are taken into consideration, for, as has been rightly suspected by Rand & Fleming, migrants, particularly early comers and late goers, complicate the picture considerably. However, so far as breeding populations in Nepal are concerned, I think the following working arrangement should prove satisfactory :

Western and west-central Nepal : *S. o. meena*
Central Nepal : *S. o. meena* ≷ *agricola*
Eastern Nepal : *S. o. agricola*

It may incidentally be noted that my casual study based mainly on the materials of the American Museum of Natural History and the British Museum as presented above, is in fair agreement with Roonwal's (1941, p. 331) observation based on the Indian Museum material.

Both Ripley and Rand & Fleming identified their breeding specimens from the Nepal Valley as *meena*. Their few examples, like some of mine and Scully's and Bailey's (at the British Museum), must be towards the *meena*-side of intergradation. The taxonomy of the species *S. orientalis* poses an intriguing problem, especially in its Indian populations, which only a thorough revisional study can solve.

218. **Streptopelia decaocto decaocto** (Frivaldszky). Indian Ring Dove.

CHITLANG VALLEY : Chitlang : 1 ♂, 1 ♀ (April 27).

The Ring Dove was not met with by us in the Nepal Valley where Proud (1955, p. 71) found it, though not normally, at the end of the monsoon in flocks feeding on paddy. However, we came across a few about cultivated fields in the Chitlang Valley, and scarcely in the central dun. All other workers reported this species only from the plains to the duns.

Measurements :

	Wing	Tail	Rhamphotheca
1 ♂ :	172	134	—
1 ♀ :	171	130	9

Compared with the populations from Iran and Afghanistan, the Indian birds are a trifle darker, with a little more grey on the lower plumage.

219. **Streptopelia tranquebarica humilis** (Temminck). Eastern Red Turtle Dove.

DUN : Hitaura : 5♂♂, 1 juv. ♂, 3 ♀♀ (May 21, June 15-23, July 10-12).

The Red Turtle Dove is not an uncommon bird in the duns of central Nepal during summer. It usually occurs in pairs or in small loose parties, feeding in the forest clearings, such as cut-up patches, forest paths, etc.

Scully (1879, p. 342) found it common in the central bhabar and dun in winter. Proud (1949, p. 718) noted it as a summer visitor, though not very common, in the Nepal Valley. Ripley (1950b) and Rand & Fleming (1957) did not record it from Nepal.

Most of my June and July specimens are worn, a few very much so. A male bird (June 15) has moulting upper tail coverts and central tail feathers, while a female (June 20) has only the upper tail coverts in moult.

Measurements :

	Wing	Tail	Rhamphotheca
5 ♂♂ :	136 (2), 140 (2), 141	86+, 89+, 90, —(2)	7, 7.5, 8, — (2)
3 ♀♀ :	136 (2), 141	83+, 87, —	7, 8.5, —

I agree with Whistler & Kinnear (1936, p. 680) in not recognizing Bonaparte's *murvensis* (=Hartert's *murmensis*), since the birds from Nepal differ very little, if at all, from those of Assam and Burma. However, there appears to be scope for further detailed study of the western and southern Indian populations, especially of their breeding ranges and movements during the non-breeding season. It may be mentioned in this connexion that in southern India where the type locality of the nominate subspecies lies, two distinct forms occur. Thus, of the four southern specimens I have examined (two from Mysore and two from Coimbatore), three are very close to Sikkim-Assam birds, that is *humilis*, while the fourth one matches well with Panjab-Uttar Pradesh birds. But this specimen could as well be a migrant from the north, it being taken on December 17.

Standard works on Indian ornithology, such as those of Baker (1928, p. 251), Peters (1937, p. 97), and Ripley (in press), have all mentioned 'western Nepal' within the range of the nominate subspecies. Although the western Nepali birds may possibly belong to that subspecies, I am unable to trace any reported collection of actual specimen of the species from that part of the country.

220. **Streptopelia chinensis suratensis** (Gmelin). Indian Spotted Dove.

BHABAR : Amlekhganj : 1 ♂, 1 ♀ (March 9, 10). DUN : Hitaura, Paharé Ghat : 3 ♂♂, 1 ♀, 2 juv. ♀♀ (May 25-28, June 10-13). NEPAL VALLEY : Kathmandu and its suburbs, Thankot : 6 ♂♂, 1 subad. ♂, 8 ♀♀, (March 20-April 23).

The Spotted Dove is one of the commonest birds of central Nepal from the bhabar up to the Nepal Valley, particularly in and around fields of paddy and pulses.

One of my adult female specimens (Kathmandu, March 24) has a few faint blackish bars on the breast, abdomen, flanks and under tail coverts. The subadult male specimen (Thankot, April 2) has the underside brownish vinous and its wing coverts are edged with rufous.

The subadult male has the upper tail coverts, a female (Kathmandu, March 20) both the rump and upper tail coverts, and a male (Hitaura, June 22) the central rectrices, in moult.

Colours of soft parts : Iris pinkish red; orbital skin and edges of eyelids pink; bill black; legs and feet dull purplish red; claws dark horny; pads white.

All the adult examples taken between March and June had breeding gonads.

Measurements : 11 ♂♂ : Wing 135, 137, 138, 142 (3), 143, 144, 146, 151, — ; tail 131, 136 (4), 137+, 138, 143, 144, 148, 150 ; rhamphotheca 7.5 (2), 8 (4), 8.5 (2), 9, —(2).

10 ♀♀ : Wing 133, 135, 136, 138.5, 139, 140, 141 (2), 143, 145 ; tail 125, 130, 131, 132, 134 (2), 135, 139, 140, 141; rhamphotheca 7.5 (3), 8 (5), 8.5, —.

221. **Chalcophaps indica indica** (Linnaeus). Indian Emerald Dove.

BHABAR : Amlekhganj : 1 ♂ (March 10). DUN : Hitaura : 5 ♂♂, 2 ♀♀ (May 12-29).

The Emerald Dove is not uncommon in the forests of the bhabar and dun of central Nepal. Scully (1879) did not report it from Nepal.

One of my female specimens (May 12) has chestnut central rectrices.

Measurements :

	Wing	Tail	Rhamphotheca
6 ♂♂ :	148, 149, 151, 152, 153, 156	92 (2), 93, 94, 95, 99	9 (3), 9.5, — (2)
2 ♀♀ :	140, 144	87, 89	8, 8.5

Order PSITTACIFORMES

Family PSITTACIDAE

222. **Psittacula eupatria nipalensis** (Hodgson). Large Indian Parakeet.

TARAI : Simra : 1 ♂ (March 5). BHABAR : Amlekhganj : 1 ♂, 1 ♀ (March 10).

The Large Indian Parakeet occurs in small numbers in the forests of the tarai and bhabar of central Nepal. Although Scully (1879, p. 240) reported it from the dun, we failed to find any there. Ripley (1950b, p. 371) and Rand & Fleming (1957, p. 72) recorded it from the lowlands of western and west-central Nepal.

Measurements :

	Wing	Tail	Culmen from cere
2 ♂♂ :	224, 234	345+, —	35, 37
1 ♀ :	215	295+	34

223. **Psittacula krameri borealis** (Neumann). Northern Indian Roseringed Parakeet.

Tarai : Simra : 1 ♂, 1 ♀ (March 4, 5). Bhabar : Amlekhganj : 1 ♂, 2 ♀♀ (March 10, June 8).

The Roseringed Parakeet is common in the tarai and bhabar in light forests and near villages.

The June specimens (1 ♂, 1 ♀) had non-breeding gonads.

Colours of soft parts : Iris pale yellow; upper mandible coral red with black tip; lower mandible black on anterior third and mixed black and red or dusky red posteriorly; legs and feet greenish slaty; claws black; pads greenish grey.

Measurements :

	Wing	Tail	Culmen from cere
2 ♂♂ :	171, 173	243, —	24 (2)
3 ♀♀ :	165, 169, 174	222+, — (2)	22, 23, 24

224. **Psittacula alexandri fasciata** (P. L. S. Müller). Indian Redbreasted Parakeet.

Psittacus fasciatus P. L. S. Müller, 1776, *Vollstädiges Natursyst.*, Suppl., : 74. (Pondicherry, South India, error, fixed at Arakan, Burma, by Ticehurst, 1933, p. 934, but see discussion below.)

Bhabar : Amlekhganj : 1 ♂, 2 ♀♀ (March 10). Dun : Hitaura 2 ♂♂, 1 juv. ♀ (May 19, June 16, July 14).

The Redbreasted Parakeet was found by us in the forests of the bhabar and dun of central Nepal in flocks of about a dozen or more. Scully (1879, p. 244) recorded it from the Nepal Valley in August-October, where subsequent workers failed to find it. Rand & Fleming (1957, p. 73) found it in west-central Nepal between *c.* 1220 and 1525 m. in winter. It is not included in Ripley's (1950b) list.

The juvenile female specimen (July 14) is green all over, and is evidently a bird of the year.

Measurements :

	Wing	Tail	Culmen from cere
3 ♂♂ :	168, 169, 171	151+, 174+, —	24, 25, 26.5
2 ♀♀ :	164, 165	150, —	24 (2)

The type locality of *Psittacus fasciatus* as given by Müller, namely Pondicherry, was evidently an error, and Ticehurst (loc. cit.) fixed it as Arakan. Müller's description of the species was based on Daubenton's *Planches enluminees*, pl. 517, which was published in 1770. The specimen(s) on which the plate was based, was collected probably before 1762 (Stresemann, 1952, p. 502). Now, Arakan was practically unknown to Europeans even in 1776, so that unless it can be proved beyond any reasonable doubt that the original specimen(s) did actually come from Arakan, it seems reasonable to attach no importance to Ticehurst's arbitrary fixation of the type locality. It may be pointed out here that Chandernagore in Bengal was in French possession during those days and earlier, and it certainly was not very difficult for a French naturalist or collector stationed there to obtain specimens from the Himalayan foothills and duars in northern Bengal. The other possibility is that the original specimen(s) did not come from India or Upper Burma at all, but from some other area within the range of the species, visited by early French collectors.

225. **Psittacula cyanocephala bengalensis** (Forster). Northern Indian Blossomheaded Parakeet.

BHABAR : Amlekhganj : 2 ♂♂, 1 ♀ (March 10). DUN : Hitaura : 1 ♂, 3 juv. ♂♂ 1 juv. ♀ (May 28, 30, June 7, 26, July 23).

The Blossomheaded Parakeet was found by us in the forests of only the bhabar and dun of central Nepal.

Although Scully (1879, p. 242) did not find it in the Nepal Valley 'except probably as a mere straggler', Proud (1949, p. 715) noted it to be moderately common on the hills round the Valley. It was not found there by Ripley (1950b, p. 371) who reported it from eastern Nepal from the tarai up to *c.* 1830 m., nor by Rand & Fleming (1957, p. 73) who found it only in the lowlands of west-central and eastern Nepal.

The juvenile specimens are all birds of the year. Of them, two males May 30, July 23) and a female (June 7) are in the first stage plumage. The other male specimen (May 28) is moulting from the first to the second stage.

The adult male bird from Hitaura (June 26) is very worn.

Measurements :

	Wing	Tail	Culmen from cere
3 ♂♂ :	141, 143, 144+	207, — (2)	18.5, 19 (2)
1 ♀ :	138	200	18

Rand & Fleming (1957, pp. 73-74) suggest synonymizing *rosa* and *bengalensis* with *cyanocephala*, with which I am unable to agree.

Nepal has been included within the range of the allied species *Psittacula roseata* Biswas (*rosa* or *bengalensis* of authors, not of Boddaert or Forster, respectively) by Baker (1927, p. 206), presumably on the basis of Salvadori's (1891, pp. 454-455) identification of Hodgson's specimens. However, such of those specimens as could be traced are all worn examples of *Ps. cyanocephala.*

226. **Psittacula himalayana** (Lesson). Slatyheaded Parakeet.

BHABAR : Amlekhganj : 2 ♂♂ (March 8, 9). DUN : Hitaura : 1 ♂ (May 24). NEPAL VALLEY : Thankot : 1 ♂, 1 juv. ♂ (April 4, 14).

The Slatyheaded Parakeet is found in small flocks in light forests of central Nepal. It does not appear to be common anywhere.

Scully (1879, p. 243) reported it only from the Nepal Valley between December and April. Proud (1949, p. 715) also noted it in the Nepal

Valley, and on the lower hills around. Ripley (1950b, p. 371) found it only once and that was in western Nepal at *c.* 1525 m. in December. Rand & Fleming (1957, p. 74) recorded it from *c.* 1370-2135 m. in west-central and central Nepal in winter. We found it, as mentioned above, between *c.* 245 and 1525 m. in central Nepal in March-May. Incidentally, the lowest altitude for this bird has been given by Ripley (in press) as *c.* 610 m.

The juvenile specimen (April 14) is green all over, and is very worn. The adult bird from Hitaura (♂, May 24) is also worn.

Measurements : 4 ♂♂ : Wing 158+, 160, 165, 168 ; tail —, 223, 224, 243 ; culmen from cere 21(2), 21.5, 23.

I agree with Husain (1959, p. 249) in treating *Ps. himalayana* as a species distinct from *Ps. finschi* (Hume).

*227. **Loriculus vernalis vernalis** (Sparrman). Indian Lorikeet.

Although the standard works on Indian avifauna, e.g. Baker (1927, p. 217), Peters (1937, p. 256), and Ripley (in press) do not include Nepal within the range of this species, Hodgson presented two skins from the 'Tarai of Nepal' to the British Museum (Gray & Gray, 1846, p. 113). It has not since been reported from Nepal, however.

Order CUCULIFORMES

Family CUCULIDAE

228. **Clamator coromandus** (Linnaeus). Redwinged Crested Cuckoo.

DUN : Hitaura : 5 ♂♂, 3 ♀♀ (May 12-June 5).

The Redwinged Crested Cuckoo is fairly common in the dun during summer in dense as well as light forests, sometimes even in thorny undergrowths and bushes. It is rather noisy, and occurs singly or in loose parties of three or four.

We were not able to locate it in the Nepal Valley where Scully (1879, p. 257) who noticed it at Godavari in May, thought it bred. Neither Ripley (1950b), nor Rand & Fleming (1957) recorded it from Nepal.

Measurements :

	Wing	Tail	Bill
5 ♂♂ :	160.5, 162, 163, 165.5, 166	238, 243+, 251,— (2)	31.5, 32 (2), 33, 33.5
3 ♀♀ :	164, 165, 168	240+, 248+, 258	32 (2), 34

229. **Clamator jacobinus serratus** (Sparrman). Pied Crested Cuckoo.

DUN : Hitaura : 1 ♂, 1 ♀ (June 21, 23).

The Pied Crested Cuckoo appears to be rather scarce in central Nepal. We came across only a few individuals in the forests at Hitaura in the dun. Scully (1879), Ripley (1950b) and Rand & Fleming (1957) failed to find it in Nepal ; and Proud (1949, p. 714) saw it only once at Kathmandu, Nepal Valley, in April.

Measurements :

	Wing	Tail	Bill
1 ♂ :	148	170	28
1 ♀ :	143	150+	26.5

230. **Cuculus sparverioïdes sparverioïdes** Vigors. Large Hawk-Cuckoo.

CHANDRAGIRI : above Thankot, above Chitlang, on the crest : 3 ♂♂ (April 6-22). Also one specimen without exact locality, date and sex.

The Large Hawk-Cuckoo is frequently heard from about the beginning of April on the ranges surrounding the Nepal Valley at *c.* 1675 m. upwards. It is also found on the Mahabharat Range in May. Nowhere, however, is it seen easily owing to the thick cover it selects. It has also been recorded in winter at *c.* 1830 m. in west-central Nepal by Rand & Fleming (1957, p. 74), and at *c.* 1525 m. in eastern Nepal in June by Biswas (1960a). Ripley (1950b) did not include it in his list.

One of my specimens (April 22) had the testes slightly enlarged, measuring 5×3.5 (right) and 6×4 (left) mm.

Colours of soft parts : Iris orange-yellow ; edges of eyelids lemon yellow ; upper mandible dark horny, paler on the tip ; lower mandible greenish slaty, dusky on the sides of anterior half and on the tip ; gape dull lemon yellow ; legs and feet lemon yellow ; claws pale horny with yellowish tinge ; pads dirty lemon yellow.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	213, 227, 228	202, 205, —	28, 29, —
1 unsexed :	225	—	30

231. **Cuculus varius varius** Vahl. Common Hawk-Cuckoo.

DUN : Hitaura : 3 ♂♂, 2 ♀♀, 1 juv. ♀ (May 19-28, June 6, 21).

This hawk-cuckoo is heard only sometimes in the Nepal Valley during April-May, but is fairly common during summer in the bhabar and dun. It is noticed around villages and the edges of forests.

It was reported breeding in small numbers in the Valley by Scully 1879, p. 256) who noted it there from February onwards. Proud (1949, p.714) recorded it to be scarce there. Ripley (1950b, p. 371) found it in the central plains (Birganj) in winter, and Rand & Fleming (1957, p. 75) in the lowlands in the same season.

The juvenile female specimen (June 21) has rufous bars next to black on tail, ill-defined rufous barrings on the upper side, and a rufous wash on the underside, heavily streaked with blackish brown.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	205, 206, 213	174, 180, 188	28, 30, 31
2 ♀♀ :	206, 207	177+, 179+	29 (2)

Regarding Hodgson's collection of *C. varius*, see note under the next form.

*232. **Cuculus fugax nisicolor** Blyth. Hodgson's Hawk-Cuckoo.

Hodgson's collection (Gray & Gray, 1846, p. 120 ; Gray, 1863, p. 66) provides the sole record of this hawk-cuckoo from Nepal. Gray & Gray, and Gray both listed Hodgson's specimens of this form and those of *C. varius* together. However, Shelley (1891, pp. 235, 238) gave four specimens of *varius* and two of *nisicolor* presented by Hodgson from Nepal.

233. **Cuculus micropterus micropterus** Gould. Indian Cuckoo.

Dun : Bhimphedi : 1 ♂, 1 ♀ (May 6, 10). Markhu Valley : Deorali : 2 ♂♂ (May 1). Chitlang Valley : Chitlang : 1 ♂ (April 16). Nepal Valley : Pashupatinath : 1 ♂ (April 28).

The Indian Cuckoo is common from the Markhu Valley to the Nepal Valley in April and May. In the upper parts of the central dun it is rather scarce in early May. We did not find it later in the bhabar and dun.

Scully (1879) did not report it from Nepal. Biswas (1960a) found it in the Arun watershed, eastern Nepal, at *c.* 1525 m. in June.

One of my male specimens (Deorali, May 1) still has traces of rufous on the upper parts.

In the male bird from the Nepal Valley, the testes had just commenced maturing.

Colours of soft parts : Iris reddish brown; edges of eyelids yellow; upper mandible dark horny with yellow on the base and gape; lower mandible pale grey with yellow on the base and dark horny on the tip; legs and feet yellow; claws dark horny; pads white.

Measurements :

	Wing	Tail	Bill
5 ♂♂ :	192, 195, 201, 204, 207	151, 159, 195+, 160,—	30, 31, 32 (2),—
1 ♀ :	207	161+	30

See note under *C. p. poliocephalus* (p. 543) regarding Hodgson's collection of *C. micropterus*.

234. **Cuculus canorus telephonus** Heine. Asiatic Cuckoo.

Dun : Hitaura : 2 ♂♂ (June 12, 21). Markhu Valley : Deorali : 1 ♂ (April Chitlang Valley : Chitlang : 1 ♂, 1 ♀ (April 16, July 2). Nepal Valley : Sheopuri Range off Burhanilkantha, Patan, Thankot : 4 ♂♂, 1 ♀ (April 12, May 2, 17).

The Asiatic Cuckoo is a common bird from the Mahabharat Range to the Nepal Valley during April-May. In the Valley it is found common in the central woods as also on the hills bordering it. In the central dun, however, it is quite scarce in May-June. The two specimens collected there by us in June might probably be late-comers from the winter quarters, or else breeding there, but no record of the condition of their gonads was unfortunately kept.

Stevens (1925b, p. 679) reported it from the Mai Valley, eastern Nepal, at *c.* 2745 m. Ripley (1950b) did not mention this species in his list. Polunin (1955, p. 895) occasionally heard it in the oak forests of the Langtang Valley, central Nepal, during June. Lowndes (1955, p. 35) found it plentiful and breeding at *c.* 3655-3960 m. in Manangbhot, central Nepal, during June-August. Biswas (1960a) found it common in eastern Nepal between *c.* 1220 and 2745 m. in June, but less common above up to *c.* 4265 m. in May.

One of my male specimens (May 2) has the throat feathers in moult.

The same specimen and another male (May 17) had the gonads just commenced swelling.

Colours of soft parts : Iris and edges of eyelids chrome yellow ; bill dark horny with yellow on the base and gape, and light grey with yellowish wash on the middle part of the lower mandible ; legs and feet yellow ; claws light grey ; pads white.

Measurements :

	8 ♂♂	2 ♀♀
Wing :	211, 215 (2), 223, 225, 226, 232, 243	217, 223
Tail :	—, 165, 167, 168, 172, 175, 183 (2)	163, 165
Bill :	26.5, 28 (2), 28.5, 29, — (3)	27.5 (2)

[cf. ♂♀ wing 220-227 ; tail 155-178, as given by Baker (1927, p. 137).]

This subspecies seems to be ill-defined indeed.

235. **Cuculus saturatus saturatus** Blyth. Himalayan Cuckoo.

DUN : Hitaura, Bhimphedi : 1 ♂, 1 juv. ♂, 1 ♀ (May 10, June 15, 17). MARKHU VALLEY : Deorali ; 1 ♂, 1 juv. ♀ (April 29, May 1). CHITLANG VALLEY : Chitlang : 1 ♂ (April 20). NEPAL VALLEY : Thankot, top of Chandragiri Range above Thankot, Godavari, Phulchauki Danda above Godavari : 9 ♂♂, 1 nestling ♂, 1 hepatic ♀ (March 29, April 4-16, May 10-12).

On the hills surrounding the Nepal Valley and on the Chitlang side of the Chandragiri, the Himalayan Cuckoo is very common from about the middle of April. Its characteristic four-noted sonorous call could be heard almost any time of the day, and even on moonlit nights. It is seldom seen below *c.* 1525 m.

The central dun birds taken in May and June might probably represent late-comers from the winter quarters.

It was not found in Nepal by Ripley (1950b). Biswas (1960a) reported it to be common between *c.* 1525 and 3050 m. in eastern Nepal in June.

Two of my males and the hepatic female, taken April 15, 16, May 12, had slightly enlarged gonads, the female having its largest ova measuring 4 and 6 mm.

The nestling (Godavari, May 10) was collected on the ground while it was being pecked at by four Redbilled Blue Magpies, apparently stolen from its foster-parent's care. It had severe injuries on the head (part of the brain was exposed), eyes and abdomen. It died soon after it was rescued from its predators.

One of the adult males (Hitaura, June 17) is in very worn plumage, except the central rectrices which are moulting.

HEPATIC FEMALE: Chin, throat and upper breast pale rufous with blackish brown bars, sides of the throat and of upper breast chestnut and blackish brown bars ; lower breast to under tail coverts white with blackish brown bars, with a slight rufous tinge on the vent and under tail coverts.

JUVENILE : Male, June 15.—General coloration dark grey-brown with white bars on the upper side, chin and throat.

Female, April 29.—Rufous with blackish brown bars all over.

NESTLING : Upper plumage and chin to breast blackish brown, with narrow white edges to feathers ; abdomen and vent faint fulvous heavily barred with broad bands of blackish brown ; primaries barred on the outer webs with rufous. Remiges and under wing coverts growing. Rectrices not yet developed.

Colours of soft parts : ADULT MALE : Iris reddish brown ; edges of eyelids yellow; upper mandible dark horny with pale yellow on the base, and greenish horny patches in front of nostrils (absent in one specimen) ; lower mandible pale greenish horny with yellow on the base, and dark horny on the edges of the anterior half and tip ; gape yellow (once orange-yellow) ; legs and feet yellow (legs once yellowish horny) ; claws horny with yellow on the tips (once fleshy) ; pads white.

HEPATIC FEMALE : Iris brownish yellow ; upper mandible dark horny, a little paler on the base, yellowish white patches in front of nostrils, and yellow on the sides below nostrils ; lower mandible horny with darker tip, and yellow on the base and sides of the proximal third ; legs and feet wax yellow; claws horny with yellow on the tips of the outer and inner ones. Eyelids, gape and pads as in adult male.

NESTLING : Iris dark brownish grey ; bill black ; legs fleshy ; feet yellowish fleshy ; claws fleshy ; pads yellowish fleshy.

Measurements :

	12 ♂♂	1 ♀	1 hep. ♀
Wing :	179+, 182, 183, 184, 185 (2), 186, 187 (2), 188, 192 (2)	186	180
Tail :	144, 145, 146+, 148, 149, 151+, 155, 156 (2),—(3)	159	147
Bill :	27, 27.5, 28 (5), 29, 30, — (3)	28	27

[cf. measurements given by Baker (1927, p. 141) : ♂♀ : wing 208-226; tail 151-176.]

Regarding Hodgson's collection of the Himalayan Cuckoo, see note under *C. p. poliocephalus* (below).

236. **Cuculus poliocephalus poliocephalus** Latham. Small Cuckoo.

MARKHU VALLEY : Deorali : 2 ♂♂ (April 28, 30). NEPAL VALLEY : Thankot : 1 ♀ (July 25).

The Small Cuckoo was seen by us only on a few occasions in deep gorges on the Chandragiri and Mahabharat ranges. It appears to be a very shy bird.

Scully (1879) did not find it in Nepal, nor was it reported thence by Rand & Fleming (1957). Stevens (1925b, p. 679) recorded it from the Mai Valley, eastern Nepal at *c.* 2135 m. in May. Ripley (1950b, p. 371) found a single specimen in the Nepal Valley in mid-April, where Proud (1955, p. 69) noted it as common between *c.* 1525 and 2135 m. in April.

My female specimen still has traces of chestnut bars on the head and nape.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	155, 155.5	130, 132	24, —
1 ♀ :	149	128	23.5

In listing Hodgson's collection of cuckoos, Gray & Gray (1846, pp. 119-120) and Gray (1863, p. 65) made a curious mixture of *C. micropterus*, *C. saturatus*, and *C. poliocephalus*. However, from a reference to Shelley (1891, pp. 243-244, 254, 257) we find that Hodgson presented 5 specimens of *C. micropterus*, 11 of *C. saturatus*, and 6 of *C. poliocephalus* to the British Museum.

237. **Cuculus sonnerati sonnerati** Latham. Indian Banded Bay Cuckoo.

DUN : Hitaura : 1 ♂ (May 26).

We came across the Banded Bay Cuckoo in Nepal once, when the specimen was collected.

Gray & Gray (1846) and Gray (1863) did not mention any specimen of this species in the Hodgson collection, but Shelley (1891, p. 264) listed two examples presented by Hodgson. This cuckoo was not reported from Nepal by Scully (1879), Ripley (1950b) or Rand & Fleming (1957).

Measurements : 1 ♂ : Wing 118 ; tail 114+; bill 25.

238. **Cuculus passerinus** Vahl. Indian Plaintive Cuckoo.

MARKHU VALLEY : Kulikhani : 1 ♂ (April 27). CHITLANG VALLEY : Chitlang: 2 ♂♂ (July 2).

The Indian Plaintive Cuckoo is scarce in Nepal. It occurs near villages between the Mahabharat and Chandragiri ranges.

After Hodgson's collection, ours appears to be the only record of this species from Nepal.

The Chitlang specimens had remains of caterpillars in their stomachs.

Measurements : 3 ♂♂ : Wing 116, 118, 120 ; tail 113, 114, 115 ; bill 22, 23 (2).

Biswas (1951b) has shown that the greybellied *C. passerinus* and the rufousbellied *C. querulus* should be treated as distinct species.

*239. **Chrysococcyx maculatus** (Gmelin). Emerald Cuckoo.

The only post-Hodgsonian record of the Emerald Cuckoo from Nepal is Proud's (1955, p. 69), who once saw a small party in Kathmandu, Nepal Valley, on September 7.

240. **Surniculus lugubris dicruroïdes** (Hodgson). Indian Drongo-Cuckoo.

Dun : Hitaura, Paharé Ghat, Bhimphedi : 8 ♂♂, 4 ♀♀ (May 5-26, June 1-19, July 20). Nepal Valley : Godavari, Thankot : 4 ♂♂ (April 13, May 10-20).

The Drongo-Cuckoo is a common bird in the wooded parts of the Nepal Valley, the bases of the hills surrounding it, and in the duns. It is usually found in the clearings and edges of forests.

Scully (1879) did not report it from Nepal, and Rand & Fleming (1957, p. 75) found it only in the lowlands.

The July specimen had caterpillars in its stomach.

The April specimens had non-breeding gonads. By May swelling of the gonads had already commenced (right testes measured 3.75-5 × 2-3 mm. and the left, 5-6 × 3-4), and in June the birds were in breeding condition. A male on June 14 had 10 × 6 (right) and 12 × 7.5 (left) mm. testes ; a female on June 11 had a 10 mm. ovum, and another female was laying on June 19,—it had an oviducal egg heavily spotted purplish around ends.

Colours of soft parts : Iris dark brown (once reddish brown) ; bill black ; legs and feet bluish slaty ; claws horny ; pads white.

Measurements :

	12 ♂♂	4 ♀♀
Wing :	138 (2), 141, 142 (2), 144, 144+, 145, 145.5, 146, 147, 148	139+, 143.5, 144, 145.5
Tail :	130+, 132, 133, 137, 138, 139 (2), 140, 141, 142,— (2)	128, — (3)
Bill :	24, 25 (2), 25.5, 26 (4), 26.5 (2), — (2)	25, 26 (2), —

[cf. tail length ♂♀ : 106-133, according to Baker (1927, p. 165).]

241. **Eudynamys scolopacea scolopacea** (Linnaeus). Indian Koel.

Nepal Valley : Pashupatinath, Thankot : 3 ♂♂, 2 ♀♀ (March 30, April 14, 28, May 20).

The Koel is common about villages of the Nepal Valley during spring and summer. It is, however, not found on the hills surrounding the Valley. Biswas (1960a) reported it from the Arun watershed, eastern Nepal, at *c.* 915-1525 m. in June.

One of my male specimens (May 20, breeding) has all the primary coverts and the outermost primary tipped white, and the four outermost secondaries narrowly fringed with white. An examination of adult male specimens available to me from all over India shows that white is present in about 13.5 per cent specimens in varying degrees on all or some wing coverts, wing feathers, upper tail coverts, tail feathers, and even feathers of the neck, breast and abdomen, the tips of rectrices frequently being very pale rufous instead of white. The birds with white-tipped feathers have all been taken in the months of February, May, September, October, and November. Reference to available literature does not give me any idea of the significance of these spots.

On April 28 a female specimen had quite a large ovary, measuring 23×25, with the largest ova 13 and 11 mm., while a male taken May 20, had a 10.5×7.5 mm. right testis.

Colours of soft parts : Iris crimson ; bill greenish horny but without greenish on the base, around nostrils and tip of upper mandible (in one specimen, however, it was dark horny on the basal half, horny on culmen and greenish horny on the anterior half) ; legs and feet plumbeous ; claws dark horny ; pads white.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	199, 202, 205	186, 189, 205	32 (2), 33.5
2 ♀♀ :	188, 192	181+, 189	32.5, 33

242. **Taccocua tristis tristis** (Lesson). Himalayan Greenbilled Malkoha.

TARAI : Simra : 1 ♀ (March 5). BHABAR : Amlekhganj : 3 ♀♀ (March 9, 10). DUN : Hitaura, Paharé Ghat, Bhimphedi : 4 ♂♂, 1 juv. ♂, 1 fledgling ♂, 6 ♀♀ (March 13, May 8—June 20, July 12). NEPAL VALLEY : Thankot : 1 ♂, 1 ♀ (April 8, 9).

The Greenbilled Malkoha is relatively a rare bird in the Nepal Valley, but in the bhabar and dun of central Nepal, it is very common in the forests, both in the dense parts and in the thorny bushes.

The coloration of the fledgling male (June 1) is similar to that of adult, birds. The tail is proportionately very small. The juvenile male (July 12) has the tail about half-grown.

A female was laying on May 24, while another on June 10 had the ovary not fully enlarged, its largest ovum being only 5 mm. Likewise a male on June 12 had the testes measuring only 6×3.5 (right) and 7×4 (left) mm.

Many of the specimens are worn, some very much so. Two female specimens (March 9 and June 10) have the central rectrices still growing, while other rectrices are fresh. Another female (June 12) has the rectrices and under tail coverts in moult. Tail moult in this species is found to be centripetal.

Colours of soft parts : ADULT : Iris brown (once crimson); orbital skin deep crimson; bill dark green with red on the base and around nostrils (once paler green on anterior two-thirds); legs and feet greenish slaty (once without green on feet); claws horny; pads white.

FLEDGLING : Iris brown, orbital skin dark brown ; upper mandible slaty horny ; lower mandible greenish horny ; legs and feet pale plumbeous ; claws dark horny ; pads white.

Measurements :

	5 ♂♂	11 ♀♀
Wing :	168, 168+, 170 (2), 171	164, —, 167+ (2), 169, 170 (2), 170+, 171, 172+, 173
Tail :	— (4), 385	— (6), 345, 390, 404, 405+, 415
Bill :	36 (2), 36.5 (2), 37	36 (5), 36.5, 37 (5

243. **Taccocua leschenaulti infuscata** Blyth. Hill Sirkeer Cuckoo.

BHABAR : Amlekhganj : 1 ♂ (March 7). DUN : Hitaura : 1 ♂, 1 ♀ (May 19).

The Sirkeer Cuckoo did not appear to us as a common bird in Nepal. It has not so far been reported from the Valley, but we came across it a few times in the central bhabar and dun, usually in scrub jungles.

The female specimen (May 19) had an enlarged ovary with the largest ovum about 6 mm. in diameter.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	156, 157	—, 226	33 (2)
1 ♀ :	158	230+	34

244. **Centropus sinensis sinensis** (Stephens). Common Crow-Pheasant.

DUN : Hitaura : 4 ♂♂, 1 juv. ♂, 1 ♀ (May 23, June 12-19).

During May and June the characteristic resonant call of the Crow-Pheasant is frequently heard in the central dun, but due to the presence of very thick undergrowth and its skulking habits, it is not so commonly seen.

Ours appears to be the only post-Hodgsonian record of this species from Nepal.

The juvenile male specimen (June 19) corresponds very closely to Baker's (1927, p. 190) description of young birds, except that my specimen has the vent downy.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	193, 200, 208, 210	222+, 246, —, 254	38, 39.5, 40, 41
1 ♀ :	207	232 +	39

A comparison of the measurements of correctly sexed specimens from northern India and southern China with those from southern Assam, Burma, Siam, and Indo-China, reveals that individual variation in size is indeed very great in each population, so that Hume's *intermedius* from 'Dhoon [=Dehra Dun], Dacca and Thayetmyo' can hardly be recognized.

245. **Centropus toulou bengalensis** (Gmelin). Lesser Crow-Pheasant.

DUN : Hitaura : 5 ♂♂, 5♀♀ (May 30, June 13-20, July 28).

The Lesser Crow-Pheasant is not uncommon in the central dun. It occurs in grass and scrub forests.

I am unable to find any record save ours for this species from Nepal since Hodgson's days.

One of the testes of a July specimen measured 14 mm. long.

Measurements :

	Wing	Tail	Bill
5 ♂♂ :	137+, 141, 143, 144, 148	163, 165, 181+, — (2)	25, 26, 27 (2), —
5 ♀♀ :	161+, 163+, 164, 166+, 169	180+, 200, — (3)	28, 29, 29.5, 30.5, —

(*To be continued*)

Revision of Indian Spiders of the genus *Cyrtarachne* (Argiopidae : Arachnida)

BY

B. K. TIKADER

(*With five text-figures*)

INTRODUCTION

The Oriental spiders of the genus *Cyrtarachne* were first described by Thorell (1895). Pocock (1900) recorded two known species of the genus and described one new species.

Two known and three new species in the collections of the Zoological Survey of India are described in this paper.

Family ARGIOPIDAE

Genus **Cyrtarachne** Thorell

(Type: *Cyrtogaster grubei* Keyserling, 1864)

1868. *Cyrtarachne*, Thorell, EUG. RESA. ZOOL. ARACH. p. 10.
1895. *Cyrtarachne*, Simon, HIST. NAT. ARAIGN. **1**, p. 880.
1895. *Cyrtarachne* Thorell, SPIDERS OF BURMA, p. 201.
1900. *Cyrtarachne*, Pocock, FAUNA OF BRITISH INDIA, ARACHNIDA p. 228.

This genus was erected by Thorell to include *Cyrtogaster grubei* Keyserling, 1864. The name *Cyrtogaster* being preoccupied in Keyserling, Thorell proposed *Cyrtarachne* in the year 1868. He has given a detailed diagnosis in his book SPIDERS OF BURMA.

Characters. Carapace unarmed, convex, median eyes not very prominent, the ocular quadrangle generally slightly wider than long, laterals contiguous. Abdomen large, wider than long, integument leathery, strongly overlapping the posterior region of cephalothorax in front. Chelicerae subapically with outer row of large teeth, which differ in size and inner row of variable number of smaller teeth.

Distribution. Mediterranean, Ethiopian, Oriental, and Australian Regions.

KEY TO INDIAN SPECIES

1.	Abdomen pointed behind	2.
	Abdomen not pointed behind	3.
2.	Abdomen with black patch below, vulva triangular	*C. inaequalis*
	Abdomen with no black patch below, vulva with a short narrow tubercle	*C. raniceps*
3.	Abdomen chocolate colour, with white patch antero-laterally, vulva kidney-shaped ..	*C. bengalensis* sp. nov.
	Abdomen yellowish with all sigilla encircled by black patch, vulva almost rounded at the base provided with two blunt tubercles ..	*C. gravelyi* sp. nov.
	Abdomen light yellowish grey, armed above with symmetrically placed tooth-like tubercles. Vulva rounded at the base but apically triangular ..	*C. biswamoyi* sp. nov.

LIST OF SPECIES

Cyrtarachne inaequalis Thorell

1895. *Cyrtarachne inaequalis* Thorell, SPIDERS OF BURMA, London. p. 201. (Type-locality : Tounghoo, Burma.)

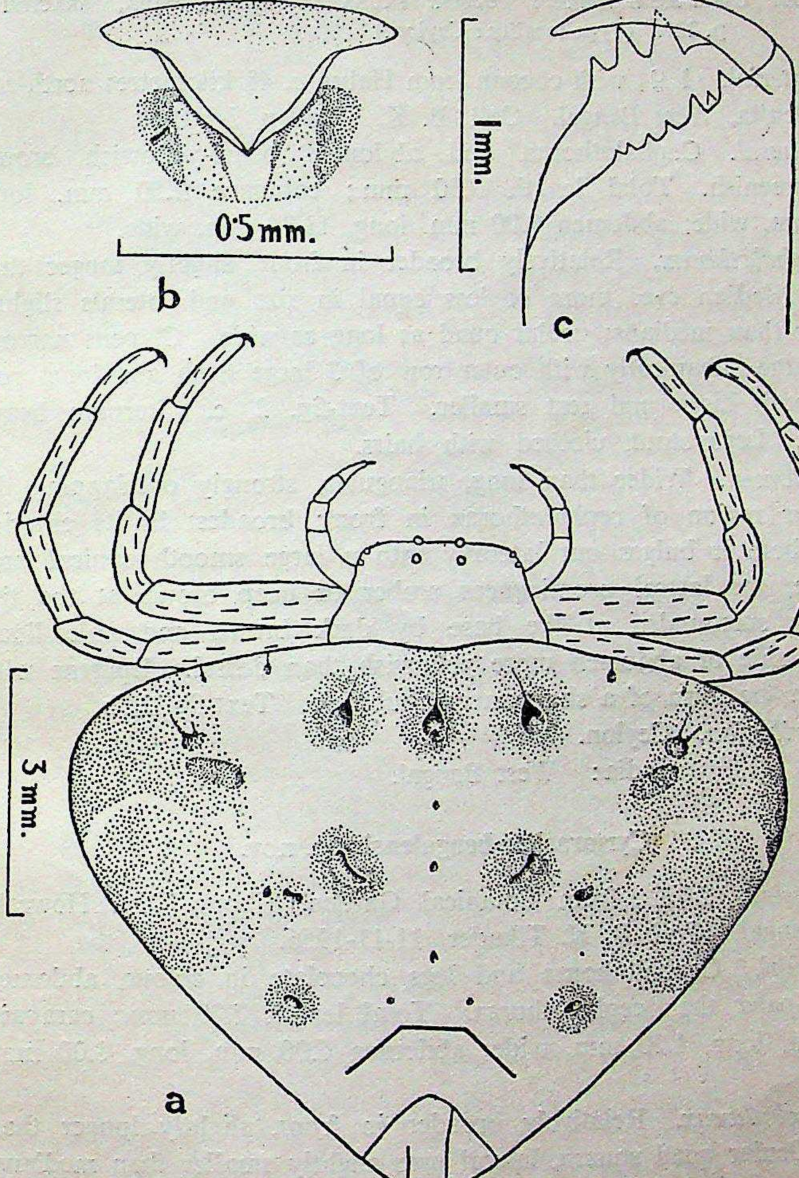
1900. *Cyrtarachne inaequalis,* Pocock, FAUNA OF BRITISH INDIA, ARACHNIDA p. 229.

Material. 2♀♀, from Botanical Garden, Sibpur, Dist. Howrah, West Bengal. Coll. B. K. Tikader, 11-11-1956; 2♀♀, from Muki, Dist. Balaghat, Madhya Pradesh. Coll. B. K. Tikader, 9-10-1957.

General. Cephalothorax ochre-yellow, abdomen yellowish, legs brownish. Total length 10.50 mm.; carapace 3.50 mm. long, 3.20 mm. wide; abdomen 9.10 mm. long, 11.00 mm. wide.

Cephalothorax. Relatively broader in front, slightly longer than wide. The area of four median eyes slightly elevated. Clypeus narrow. Chelicerae subapically with outer row of 3 large teeth and inner row first and third teeth large and rest smaller. Text-fig. 1, c. Sternum heart-shaped. Legs stout, clothed with hairs.

Abdomen. Triangular, strongly overlapping the posterior region of cephalothorax in front; wider than long, anterior lateral surface bulging out into a smooth conical prominence and furnished with a dark brown patch. Ventral surface of the abdomen black behind the epigastric fold. Epigyne triangular at the base but apically pointed. Text-fig. 1, b.



Text-fig. 1. *Cyrtarachne inaequalis* Thorell
(a) Dorsal view of whole body; (b) Epigyne; (c) Chelicera

Distribution. Burma: Tounghoo and Tharrawaddy.
India: West Bengal; Balaghat Dist., Madhya Pradesh.

Cyrtarachne raniceps Pocock

1900. *Cyrtarachne raniceps* Pocock, FAUNA OF BRITISH INDIA, ARACHNIDA p. 229. (Type-locality : Ceylon.)

Material. 1 ♀, with cocoon from Habra *c.* 48 kilometres north-east of Calcutta, West Bengal. Coll. B. K. Tikader, 7-9-1958.

General. Cephalothorax and abdomen ochre-yellowish brown, legs greenish. Total length 9.30 mm.; carapace 2.50 mm. long, 2.00 mm. wide; abdomen 9.00 mm. long, 11.70 mm. wide.

Cephalothorax. Relatively broader in front, slightly longer than wide. Median eyes more or less equal in size and laterals slightly smaller than medians; ocular quad as long as wide. Clypeus narrow. Chelicerae subapically with outer row of 3 large teeth and inner row first tooth large and rest smaller. Text-fig. 2, c. Sternum heart-shaped. Legs stout, clothed with hairs.

Abdomen. Wider than long, triangular, strongly overlapping the posterior region of cephalothorax in front; broadest in its anterior half, where it bulges out laterally into a large smooth conical prominence, the lateral prominences amber or deep brown at the tip, partially surrounded at the base by dark brown and pale lines. Ventral side of abdomen more yellowish than dorsal. Epigyne with scape in the form of a short narrow tubercle. Text-fig. 2, b.

Distribution. Ceylon.
India: West Bengal.

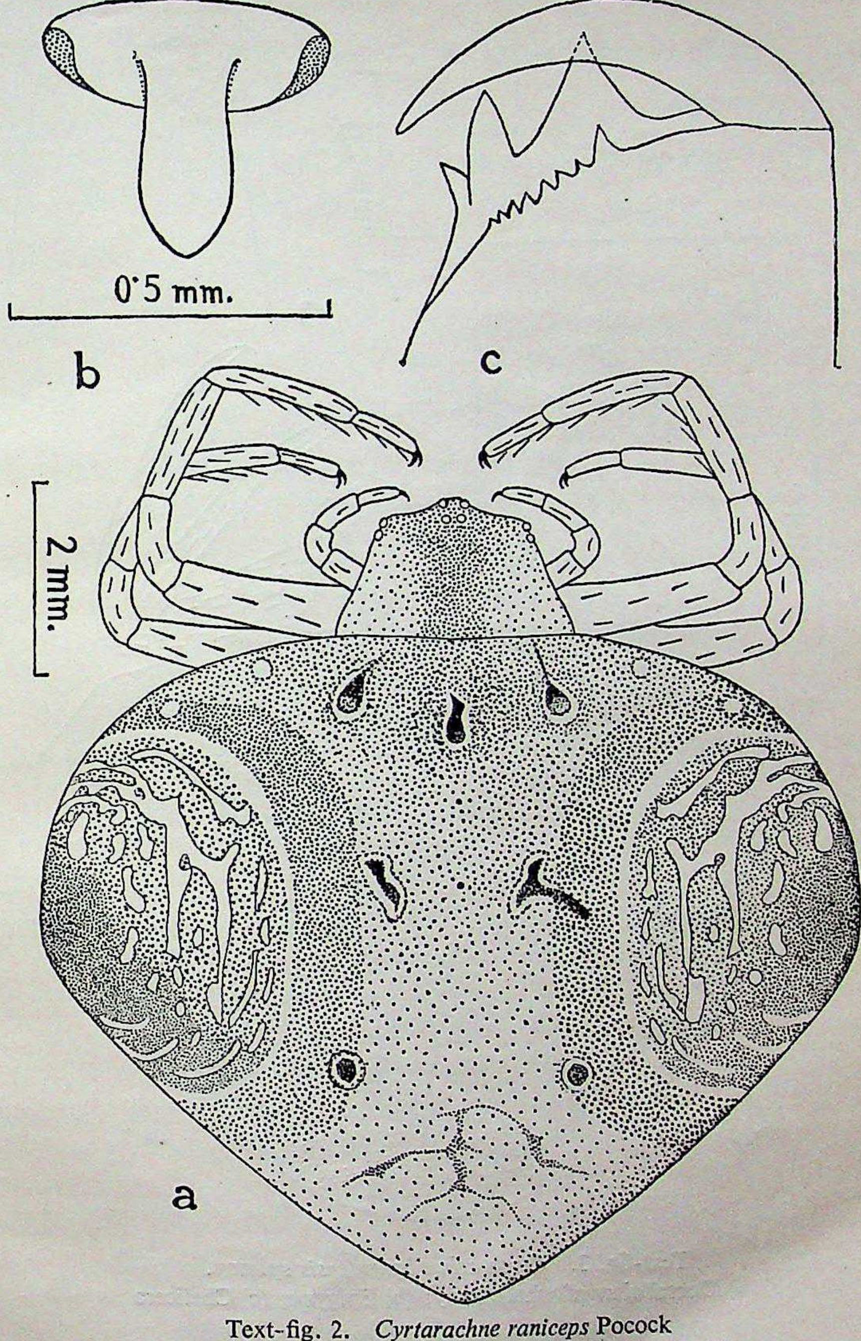
Cyrtarachne bengalensis sp. nov.

Material. 2♀♀, from Botanical Garden, Sibpur, Dist. Howrah, West Bengal. Coll. B. K. Tikader, 11-11-1956.

General. Cephalothorax and legs chocolate in colour, abdomen slightly paler than cephalothorax. Total length 7.20 mm.; carapace 2.00 mm. long, 1.20 mm. wide; abdomen 6.00 mm. long, 8.00 mm. wide.

Cephalothorax. Relatively broader in front, slightly longer than wide. Ocular quad square, lateral eyes slightly smaller than medians. Clypeus narrow. Chelicerae subapically with outer row of three large teeth and inner row of three small teeth. Text-fig. 3, c. Sternum heart-shaped, pointed behind. Legs short, clothed with hairs.

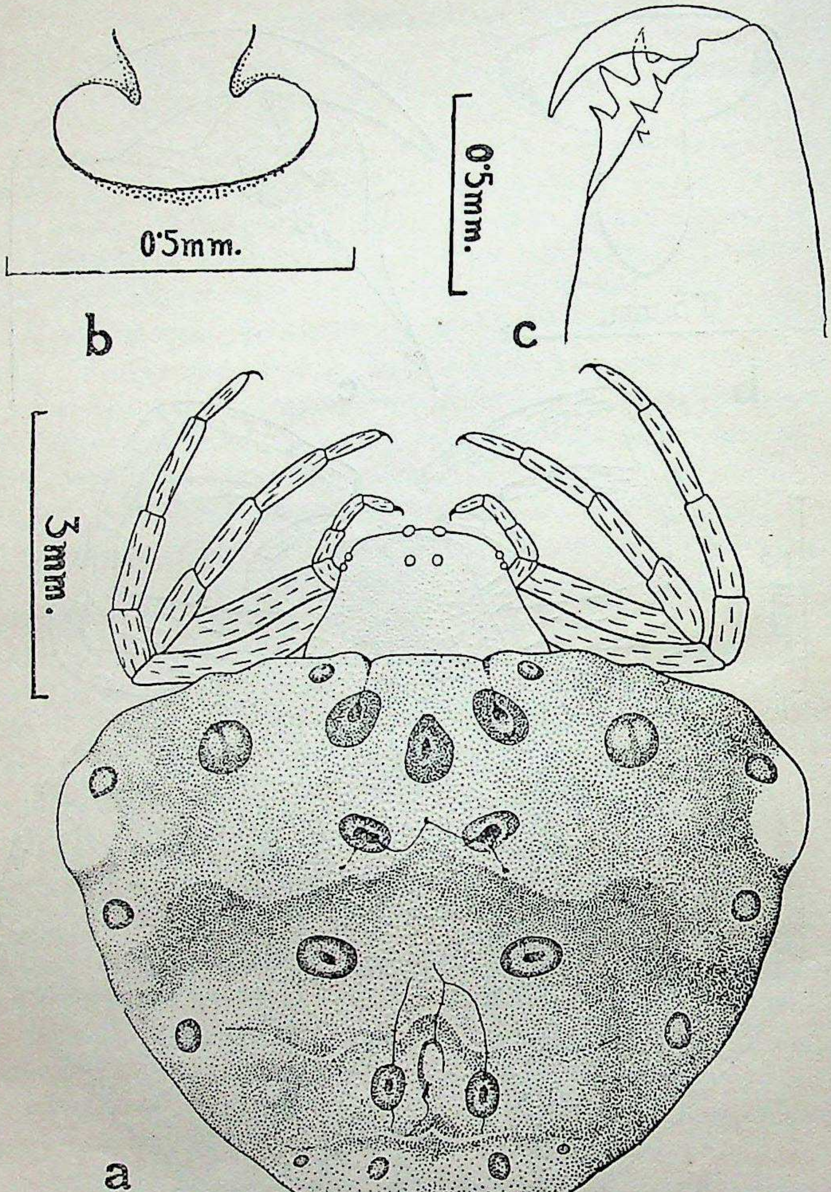
Abdomen. Moderately rounded posteriorly, strongly overlapping the posterior region of cephalothorax in front, wider than long, anterior lateral surface slightly bulging out into a smooth prominence and furnished with a white patch. Epigyne broad elongated at the base but apically kidney-shaped. Text-fig. 3, b.



Text-fig. 2. *Cyrtarachne raniceps* Pocock
(a) Dorsal view of whole body; (b) Epigyne; (c) Chelicera

Holotype. One female in spirit in the National Zoological Collections, Zoological Survey of India, Calcutta.

This species resembles *Cyrtarachne cingulata* Thorell, but is



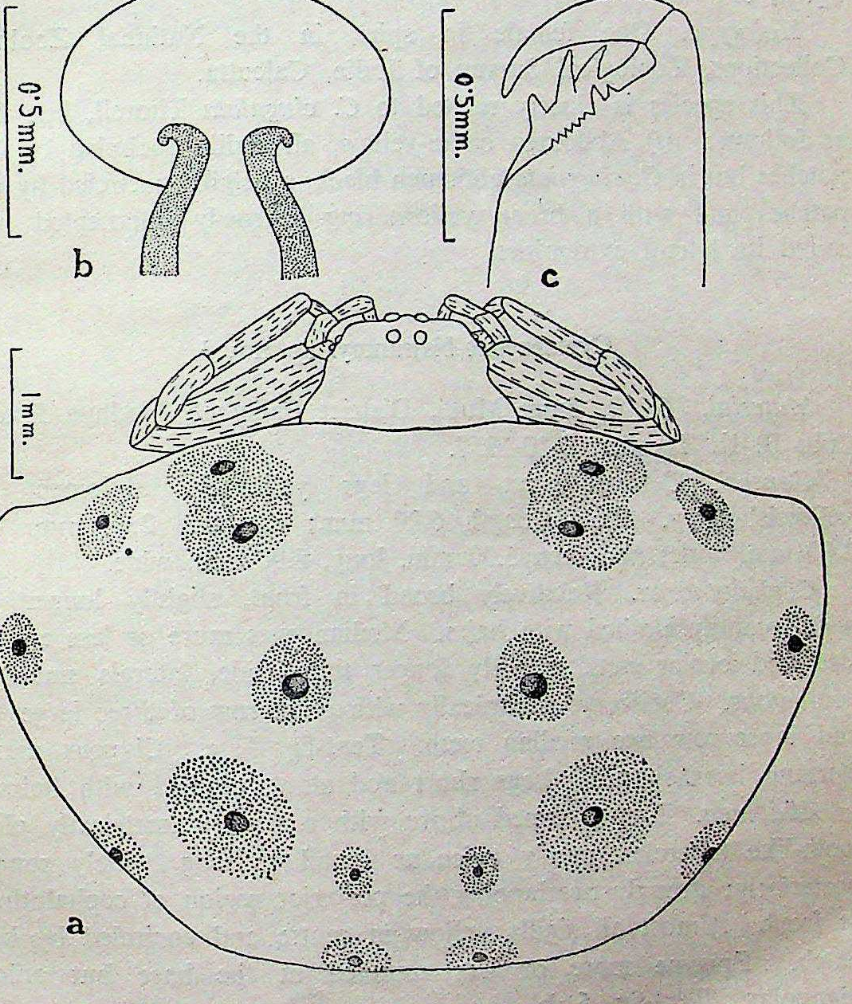
Text-fig. 3. *Cyrtarachne bengalensis* sp. nov.
(a) Dorsal view of whole body; (b) Epigyne; (c) Chelicera

separated as follows: (i) Abdomen pale chocolate-coloured, moderately rounded posteriorly and anterior lateral extremities with a white patch but in *C. cingulata* abdomen black, widely rounded posteriorly and with a broad yellow ring narrowly interrupted below round its lateral extremities.

Cyrtarachne gravelyi sp. nov.

Material. 1♀, from Pashok, Darjeeling District, West Bengal. Coll. F. H. Gravely, 26-5-1916.

General. Cephalothorax and legs light yellowish, abdomen ochre-yellow. Total length 6.00 mm.; carapace 1.60 mm. long, 1.50 mm. wide; abdomen 5.00 mm. long, 7.30 mm. wide.



Text-fig. 4. *Cyrtarachne gravelyi* sp. nov.
(a) Dorsal view of whole body; (b) Epigyne; (c) Chelicera

Cephalothorax. Relatively broader in front, slightly longer than wide. Cephalic region high, median eyes more or less equal in size and ocular quad as long as wide, lateral eyes small and contiguous. Chelicerae subapically with outer row of three large teeth and inner row first two teeth large and rest smaller. Text-fig. 4, c. Clypeus narrow. Sternum heart-shaped. Legs short and stout, clothed with hairs.

Abdomen. Large, nearly twice as broad as long, widely rounded posteriorly; strongly overlapping the posterior region of cephalothorax in front. All sigilla encircled by black patches. Ventral surface of abdomen deep brown behind the epigastric fold. Epigyne more or less rounded at the base provided with two blunt tubercles. Text-fig. 4, b.

Holotype. One female in spirit in the National Zoological Collections, Zoological Survey of India, Calcutta.

This species is closely related to *C. cingulata* Thorell, but differs as follows: (i) Abdomen ochre-yellow, all sigilla encircled by black patches but in *C. cingulata* abdomen black, all sigilla encircled by white patches and with a broad yellow ring narrowly interrupted below round its lateral extremities.

Cyrtarachne biswamoyi sp. nov.[1]

Material. 6♀♀, from Muki, District Balaghat, Madhya Pradesh. Coll. B. K. Tikader, 9-10-1957.

General. Cephalothorax and legs yellowish, abdomen light yellowish grey. Total length 6.20 mm.; carapace 2.60 mm. long, 2.00 mm. wide; abdomen 5.00 mm. long, 8.90 mm. wide.

Cephalothorax. Relatively broad in front, slightly longer than wide, scantily clothed with hairs. Median eyes more or less equal in size and ocular quad slightly longer than wide, laterals small and contiguous. Chelicerae subapically with outer row of three large teeth and inner row two median teeth. Text-fig. 5, c. Clypeus narrow. Sternum heart-shaped. Legs short and stout, clothed with hairs.

Abdomen. Large, armed above with a few symmetrically placed tooth-like tubercles, nearly twice as broad as long, widely rounded posteriorly; strongly overlapping the posterior region of cephalothorax in front. Almost all sigilla yellow in centre and encircled by black patch. Epigyne more or less rounded at the base but apically triangular. Text-fig. 5, b.

Holotype. One female in spirit in the National Zoological Collections, Zoological Survey of India, Calcutta.

This species is closely related to *C. cingulata* Thorell, but differs

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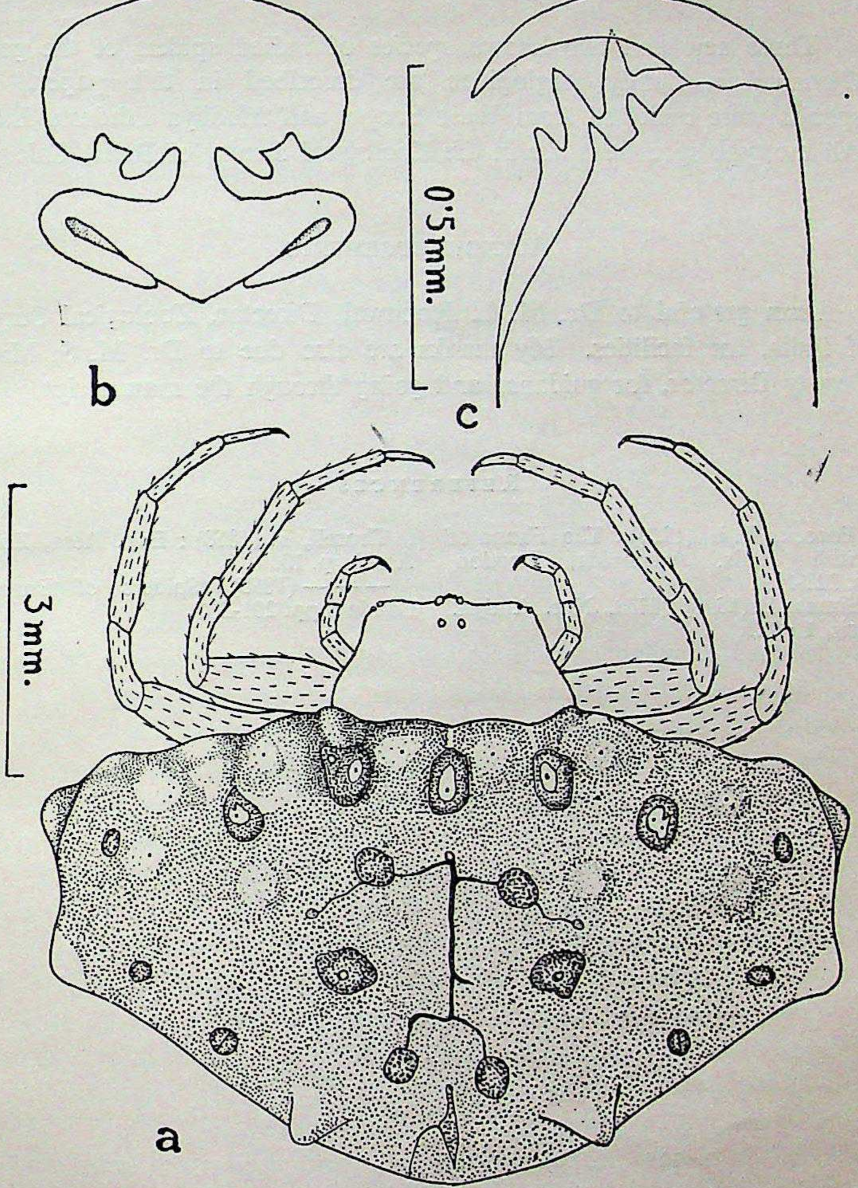
[1] I have pleasure in naming this after Dr. Biswamoy Biswas, Ornithologist, Zoological Survey of India, Calcutta.



Text-fig. 5. *Cyrtarachne biswamoyi* sp. nov.
(a) Dorsal view of whole body; (b) Epigyne; (c) Chelicera

as follows: (i) Abdomen light yellowish grey, sigilla yellow in centre and encircled by black patch but in *C. cingulata* abdomen black, sigilla black in centre and encircled by white patch. (ii) Abdomen armed above with a few symmetrically placed tooth-like tubercles but in *C. cingulata* abdomen rounded and smooth.

SUMMARY

Three new and two known species of Indian spiders of the genus *Cyrtarachne*, family Argiopidae are described in this paper. All species were collected from West Bengal and Madhya Pradesh, India. All the type specimens are in the Zoological Survey of India, Calcutta.

ACKNOWLEDGEMENTS

I am grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, for facilities. My thanks are also due to Dr. M. S. Mani, Deputy Director, for guidance and going through the manuscript.

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Simon, E. (1895) : Hist. Nat. Araign. Paris, **1** : 880.

Thorell, T. (1868) : Eug. Resa, Zool. Arach. p. 10.

——— (1895) : Spiders of Burma, London, pp. 201-207.

Thysanoptera from the Nilgiri and Kodaikanal Hills (South India)

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(*With six figures*)

The Nilgiri and Kodaikanal hill ranges of south India constitute a favourable collecting ground for Thysanoptera in view of their rich vegetation, both natural and introduced. Aid given by the Sir Dorabji Tata Memorial Trust through the Bombay Natural History Society enabled the author to make a survey of the Thysanoptera of this area, the results of which form the basis of this paper. Apart from the discovery of a new genus *Aroidothrips*, some of the rarer genera as *Bolacothrips* Priesner, *Apterygothrips* Priesner, and *Stictothrips* Hood were recorded, their corresponding species being new. In addition, *Ramaswamiahiella kallarensis* sp. nov. and *Dolichothrips* (*Dolicholepta*) *rambhutanae* sp. nov. are described and records new to the Indian region, such as *Haplothrips euphorbiae* Priesner and *Sericothrips occipitalis* Hood, are included.

Several species of horticultural importance causing severe damage to the flowers of such plants as carnations, gladiolus, orchids, iris, asters, hollyhocks, and a host of others listed below, mostly introduced into our mainland and thriving generally at high altitudes in extensive and well-maintained gardens, have been recorded during the course of the present study. The role played by thrips in causing serious economic losses to horticulturists is a recognised fact abroad, but no record exists in India of the intensity of thrips infestation on ornamental plants. Besides the presence of casual visitors and others of minor importance as pests, the following species deserve special mention as proving destructive to flowers or having sufficient potentialities of becoming serious pests : *Thrips tabaci* Lindeman on carnations, *Thrips florum* Schmutz, *Thrips melaneurus* Bagnall, and *Thrips palmi* Karny on different species of roses, *Thrips nilgiriensis* Ramakrishna on orchids, *Taeniothrips simplex* Morrison on gladiolus, *Haplothrips gowdeyii* (Franklin) and *Trybomiella ramakrishnai* Karny on hollyhocks, canna, etc. No information is available on thrips infesting glass-houses in India ; attempts to collect them from the few glass houses at Ootacamund proved futile, the only species obtained being *Heliothrips haemorrhoidalis* (Bouche) from flowers of begonia.

LIST OF SPECIES RECORDED

Suborder TEREBRANTIA Haliday

- *Sericothrips graminis* Ananthakrishnan
- *Sericothrips occipitalis* Hood
- *Aptinothrips rufus* (Gmelin)
- *Scirtothrips dorsalis* Hood
- *Anaphothrips* (*Neophysopus*) *flavicinctus* (Karny)
- *Exothrips madrasensis* Ananthakrishnan
- *Ramakrishnothrips jonnaphila* (Ramakrishna)
- *Ramakrishnothrips cardamomi* (Ramakrishna)
- *Frankliniella sulphurea* Schmutz
- *Taeniothrips distalis* Karny
- *Taeniothrips simplex* (Morrison)
- *Aroidothrips longistylus* gen. et sp. nov.
- *Bolacothrips bicolor* sp. nov.
- *Ramaswamiahiella kallarensis* sp. nov.
- *Thrips florum* Schmutz
- *Thrips tabaci* Lindeman
- *Thrips parvus* Schmutz
- *Thrips apicatus* Priesner
- *Thrips nilgiriensis* Ramakrishna
- *Thrips bambusae* Shumsher
- *Thrips melaneurus* Bagnall
- *Thrips palmi* Karny
- *Heliothrips haemorrhoidalis* Bouche
- *Helionothrips kadaliphila* (Ramk. & Marg.)
- *Caliothrips indicus* (Bagnall)

Suborder TUBULIFERA Haliday

- *Stictothrips fimbriata* (Ananthakrishnan)
- *Hoplothrips indicus* sp. nov.
- *Bamboosiella bicoloripes* Ananthakrishnan
- *Haplothrips* (*Trybomiella*) *ramakrishnai* Karny
- *Haplothrips gowdeyii* (Franklin)
- *Haplothrips euphorbiae* Priesner
- *Xylaplothrips pictipes* Bagnall
- *Dolichothrips* (*Dolicholepta*) *rambhutanae* sp. nov.
- *Praepodothrips indicus* Priesner & Seshadri
- *Praepodothrips priesneri* Ananthakrishnan

Praepodothrips cymbopogoni Ananthakrishnan
Apterygothrips pini sp. nov.
Gynaikothrips karnyi Bagnall
Gynaikothrips interlocatus Karny
Cercothrips tibialis Zimmerman

Sericothrips graminis Ananthakrishnan

1956. *Sericothrips graminis* Ananthakrishnan, T. N. *in* Zool. Anz. **156** : 31-33.

NILGIRIS : Coonoor, Sims Park 5500′, 2 females on grass, 10-5-1959.

A typical grass inhabiting bicolorous species with abdominal segments I-V yellow and VI-X dark grey-brown. Longitudinal vein of forewing with 24 bristles.

Sericothrips occipitalis Hood

1917. *Sericothrips occipitalis* Hood, J. D. *in* Bull. Brook. Ent. Soc. **12** (2) : 32-34.

NILGIRIS : Burliar Fruit Research Station 2500′, 8 females and 4 males on leaves of *Pueraria phaseoloides*, 8-5-1959.

This species is a new record to India and is allied to *S. graminis* Ananthakrishnan, with 3 abdominal segments predominantly yellow. Foreangles of pronotum produced acutely and reticulations on occiput and pronotal area outside plate, distinctly net-like.

Aptinothrips rufus (Gmelin)

1788. *Thrips rufa* Gmelin, Caroli Linn. Syst. Nat. : 2224.
1836. *Aptinothrips rufa* Haliday, A. H. *in* Ent. Mag. **3**.
1902. *Aptinothrips rufa* Hinds, H. E. *in* Proc. U.S. Nat. Mus. **26**.
1935*a*. *Aptinothrips rufus* Speyer, E. R. *in* Trans. R. Ent. Soc. Lond. **8** : 483-508.

NILGIRIS : Pomological Station, Coonoor 5500′, 6 females on grass, 10-5-1959.

Though this is a typical grass-infesting form common throughout Europe, U.S.A., Egypt, Chile, etc., it has not so far been recorded from India on grasses as far as the available literature shows. However, *Aptinothrips rufus* var. *connaticornis* Bagnall has been recorded from Darjeeling in tea flowers.

Scirtothrips dorsalis Hood

1919. *Scirtothrips dorsalis* Hood, J. D. *in* Insec. Inscit. Menstr. **7** : 90-91.

1932. *Scirtothrips dorsalis* Ramakrishna, T. V. *in* Agr. Livestk. Ind. **2** (4) : 393-394.

NILGIRIS : Kallar Fruit Research Station 1500′, 6 females on flowers of wood apple, 8-5-1959.

Anaphothrips (Neophysopus) flavicinctus (Karny)

1912. *Euthrips flavicinctus* Karny, H. H. *in* Marcellia **11** : 115.

1913. *Neophysopus medioflavus* Schmutz *in* Sitz. Akad. Wiss. Wien. **112** : 1017.

1919. *Euthrips citricinctus* Bagnall, R. S. *in* A. M. N. H. (9) **4** : 270.

1925. *Anaphothrips flavicinctus* Karny, H. H. *in* Ark. Zool. **17** : 17.

1928. *Anaphothrips* (*Euthrips*) *citricinctus* Ramakrishna, T. V. *in* Mem. Dept. Agr. Ind., Ent. ser., (7) **10** : 269.

NILGIRIS : Coonoor Pomological Station 5500′, numerous females on grass, 10-5-1959. KODAIKANAL : Shembaganur, Sacred Heart College 5000′, numerous females on grass, 5-6-1959.

One of the commonest species of grass-inhabiting thrips, this species exhibits alary polymorphism, with macropterous, brachypterous, and apterous individuals. Only 4 brachypterous and 2 apterous females were collected, the rest being macropterous.

Exothrips madrasensis Ananthakrishnan

1956. *Exothrips madrasensis* Ananthakrishnan, T. N. *in* Zool. Anz. **157** : 130-132.

NILGIRIS : Coonoor Pomological Station 5500′, 2 females on grass, 10-5-1959.

Ramakrishnothrips jonnaphila (Ramakrishna)

1928. *Taeniothrips jonnaphila* Ramakrishna *in* Mem. Dep. Agri. Ind., Ent. ser., (7) **10** : 256-258.

1940. *Physothrips jonnaphila* Ramakrishna, Cat. Ind. Insects, pt. 25 : 21.

1942. *Ramakrishnothrips jonnaphila* Shumsher *in* Indian J. Ent. **4** (2) : 6-7.

1945. *Ramakrishnothrips jonnaphila* Shumsher, ibid. **7** : 154.

Kodaikanal : Perumalmalai Hills 5500′, numerous males and females on leaf-sheaths of *Sorghum* and wild cane, 5-5-1959.

The above species is distinguished from *R. cardamomi* (Ramakrishna) by the absence of a comb on the VIII abdominal segment, costa of forewing with 24-28 bristles and lower vein with 13-14 bristles.

Ramakrishnothrips cardamomi (Ramakrishna)

1935. *Taeniothrips cardamomi* Ramakrishna *in* Bull. Ent. Res. **26**: 35-38.

1942. *Ramakrishnothrips cardamomi* Shumsher *in* Indian J. Ent. **4** (2) : 6-7.

1945. *Ramakrishnothrips cardamomi* Shumsher, ibid. **7** : 154.

Nilgiris : Burliar Fruit Research Station 2500′, numerous males and females on leaf-sheaths and leaves of cardamom, 8-5-1959. Kodaikanal : Numerous males and females inside leaf-sheaths of Cannaceae, Bryant's Park, 4-6-1959.

This species is characterised by the presence of a comb on the VIII abdominal segment, costa of forewing with 14 or 15 bristles and lower vein with 5 bristles.

Frankliniella sulphurea Schmutz

1913. *Frankliniella sulphurea* Schmutz *in* Sitz. Akad. Wiss. Wien. **112** : 1019.

Kodaikanal : Bryant's Park 6500′, numerous females on *Chrysanthemum* flowers and flowers of *Hibiscus*, 4-6-1959.

This is one of the commonest flower-infesting thrips having a very wide distribution and extremely polyphagous habit.

Taeniothrips distalis Karny

1913. *Taeniothrips distalis* Karny, H. H. *in* Archiv. F. Naturgeschichte: 122.

1916. *Taeniothrips distalis* Bagnall, R. S. *in* A. M. N. H. (8) **17**: 218.

Nilgiris : Ootacamund, Raj Bhavan Gardens 7000′, 2 females on Papilionaceous flowers, 11-5-1959.

Taeniothrips simplex (Morrison)

1930. *Physothrips simplex* Morrison, G. D. *in* Bull. Ent. Res. **21** (1) : 12-13.

1938. *Taeniothrips simplex* Bailey, S. F. *in* Univ. Calif. Col. Agri. Expt. Sta. **346** : 50-52.

NILGIRIS : Raj Bhavan Gardens 7000′, several females on *Gladiolus* flowers and leaves, 11-5-1959. KODAIKANAL : Shembaganur, Sacred Heart College Gardens 5000′, numerous females on *Gladiolus* flowers and leaves; Mt. St. Mary's 7500′, numerous females on *Gladiolus* flowers, 5-6-1959.

The *Gladiolus* thrips is a cosmopolitan form known from widely separated countries of the world and presumably introduced into India with corms, in view of their ability to reproduce on their surface. Unlike *Thrips tabaci*, this has a very limited host range and of the several plants examined its presence was recorded only from *Gladiolus* primarily and on carnations and iris occasionally. That this is assuming major pest proportions is evident from the fact that in several *Gladiolus* plants badly damaged flower buds were observed which failed to open. In the otherwise red or purple petals of the flowers, bleached areas or irregular silvery patches appeared due to the feeding of the adults and larvae in considerable numbers.

Genus **AROIDOTHRIPS** gen. nov.

Body slender. Head wider than long, transversely reticulate at base; eyes large, occupying ¾ head length. Antenna 8-jointed, long and thin, 3.7 times head length; joint 2 of style 2½ to 3 times as long as joint 1; sense cones on 3 and 4 forked, long and stout; antennal joints densely setose. Mouth cone short and blunt, maxillary palp 3-jointed. Prothoracic bristles very well developed, outer postangulars much longer than inner; anteroangulars shorter than anteromarginals. Wings present, normal; bristles and veins well developed, the lower vein with a continuous series. Lateral portions of abdominal tergites without net sculpture. Apex of abdomen not tubiform or unusually narrowed.

This new genus is closely allied to *Ayyaria* Karny and *Diarthrothrips* Williams but differs from them in the 3-jointed maxillary palpi, the nature of the antennal style and the sense cones.

Aroidothrips longistylus sp. nov.

Macropterous female :

General colour yellow with plenty of grey areas. Antennal joints uniform grey, sense cones pale. Head and thorax yellowish grey; pterothorax dark yellow mesad, greyish yellow at sides; abdominal segments II-VIII at anterior margins with bands of light grey pigments and with little red pigment mesad; anterior and posterior borders of prothorax with red pigment. Forewings uniform grey-brown ; bristles not hyaline, dark.

Head wider than long, 147 μ across eyes, 126 μ at base and 105μ long (Fig. 1A). Eyes large, 70 μ long and equally wide. Cheeks with weak setae and head at base with transverse striae. Antenna very characteristic (Fig. 1a), 3.7 times head length, with a long, fine style, the terminal joint of which is 2½ to 3 times as long as joint 1 ; joint 4 long and bottle-like ; sense cones on 3 and 4 forked, long and stout, that on 3, 54 μ long and 22 μ between arms, that on 4, 64 μ long and 18 μ between arms ; antennal joints : length (width) in μ : 26-32 (29), 35-38 (29), 61 (26-29), 87-90 (26), 55-58 (19), 58-67 (18), 10 (6), 25-29 (4) ; setae on antennal joints very well developed, long and pointed, measuring 48-58 μ long and disposed as in the figure. Mouth cone short and blunt ; maxillary palp 3-jointed, 45 μ long, individual joints measuring 19, 10, and 16 μ long respectively.

Prothorax 126 μ long, 140 μ wide at anterior margin and 168 μ across posterior margin. Prothoracic bristles very well developed ; anteroangulars shorter, 32 μ long, anteromarginals 51 μ long ; outer and inner postangulars 19 μ and 58 μ long respectively ; lateral margins on scale with smaller bristles, 19-22 μ long.

Forewings 700 μ long, 70 μ wide at base, 42 μ at middle and 35 μ tip.

Chaetotaxy : costa, 24 ; upper vein, 6 at base and 1 at tip ; lower vein, 11 in a row. Wing bristles well developed ; costal bristles 51 μ long ; basal lower vein bristles 48 μ long, distal one 67 μ long ; fringes 252 μ long.

Abdomen at base uniformly wide, 210 μ ; abdominal tergites devoid of lateral polygonal reticulations ; bristles of IX : outer 78, middle 102, and inner 112 μ long ; bristles of X : inner 99, outer 67 μ long.

Total body length 1.4 mm.

KODAIKANAL : Bryant's Park 7000′, 2 females on Arum lily (*Richardia* sp.) flowers, 6-6-1959.

Genus **BOLACOTHRIPS** Uzel

1895. *Bolacothrips* Uzel, H. *in* Mon. Ord. Thys. : 212.

This genus is being recorded for the first time in India and is characterised by the slender body, simple sense cones, 7-jointed antenna, 2 pairs of postocellar bristles and posterior prothoracic angles with a pair of bristles of about equal length.

Bolacothrips bicolor sp. nov.

Macropterous female :

Body bicolorous ; head and thorax yellow, with a greyish tinge ; antennae and abdomen brown. Wings pale at basal third, dark brown at middle, and pale brown at apex.

Head 112 μ long from fore margin of eyes, about as wide across eyes. Eyes well developed, postoculars 60 μ long, pointed. Antenna 7-jointed (Fig. 2), joints 3-7 measuring length (width) in μ : 45 (19), 45 (22), 38 (19), 49 (19), 16 (10). Sense cones on 3 and 4 simple. Mouth cone broadly rounded, 96 μ long, 80 μ wide at base, reaching beyond the middle of the prosternum. Maxillary palp 3-jointed, 38 μ long, individual joints measuring 13, 10, and 16 μ long respectively.

Prothorax 168 μ long with numerous well-developed bristles on scale. Anteromarginals 48 μ long ; outer postangulars 83 μ, inner 80 μ long. Pterothorax 280 μ long and 224 μ wide. Forewings 714 μ long, 64 μ wide at base, 48 at middle, and 35 at tip. Chaetotaxy : costa 22 ; upper vein, 6 at base and 1+1+1 beyond base ; lower vein 10 in a row.

Abdomen broad at base distinctly narrow at apex. Bristles of IX : outer 128, middle 196, and inner 64 μ long. Bristles of X : outer 90 and inner 105 μ long.

Total body length 1.4 mm.

KODAIKANAL : Bryant's Park 7000′, 1 female on *Agapanthus* flowers, 6-6-1959.

This is the only bicolorous species of *Bolacothrips* and hence easily distinguishable from the other species, *B. jordani* Uzel, *B. orientalis* Priesner, and *B. africanus* Faure.

Genus **RAMASWAMIAHIELLA** Karny

1926. *Ramaswamiahiella* Karny, H.H. *in* Mem. Dept. Agr. Ind., Ent. ser., (6) **9** : 208.

The genus *Ramaswamiahiella* is distinctly separated from the genus *Thrips* by the posterior margin of the sternites possessing at least 6 pairs of bristles.

Ramaswamiahiella kallarensis sp. nov.

Macropterous female :

General colour yellowish grey.

Antennal joint 1 pale, 2 dark grey, 3-7 yellowish grey. Wings pale greyish infumate ; abdomen uniform greyish brown.

Head wider than long, 126 μ wide and 84 μ long. Eyes large, 56 μ long and 42 μ wide. Antenna nearly 2.7 times head length ; antennal joints length (width) in μ : 22 (26), 32 (22), 35 (19), 38 (19), 35 (16), 45 (16), 13 (6).

Prothorax 140 μ wide across anterior margin 154 μ wide at posterior margin ; outer and inner postangular prothoracic setae 32 and 38 μ long respectively. Pterothorax as long as wide, 210 μ long. Wings 750 μ long, 70 μ wide at base; chaetotaxy: costa 27; upper vein 3+3; lower vein 16 in a row.

Abdominal segments broad at base gradually narrowed at apex. Bristles of IX: outer 64, middle 83, and inner 73 μ long. Bristles of X: inner 73 and outer 76 μ long.

Total body length 1.162 mm.

NILGIRIS: Kallar Fruit Research Station 1500′, 1 female on flowers of wood-apple among females of *Scirtothrips dorsalis*, 8-5-1959.

The present species differs from the only hitherto known species *subnudula* Karny by the larger size of the body and the difference in the chaetotaxy of the wings, particularly in the upper and lower veins. *R. subnudula* is a minute form measuring 0.75 to 0.95 mm.

Thrips florum Schmutz

1913. *Thrips florum* Schmutz *in* Sitz. Akad. Wiss. Wien. **122**: 1003.
1942. *Thrips florum* Karny, H.H. *in* Arkiv. Zool. **17**: 15.
1934. *Thrips florum* Priesner, H. *in* Natur. Tidschr. Neder. Inde. **94**: 261.
1940. *Thrips florum* Ramk. & Marg. *in* Cat. Ind. Insects, pt. 25: 21-22.

NILGIRIS: Ootacamund, Raj Bhavan Gardens 7000′, several males and females on different species of roses, *Anemothecum*, *Hibiscus* flowers, and numerous other flowers of ornamental value (*vide infra*), and knolkohl leaves, cabbage leaves, etc., 11-5-1959. KODAIKANAL: Shembaganur, Sacred Heart College Gardens 5500′, numerous females in flowers of *Agapanthus*, *Antirrhinum*, *Hibiscus*, *Crotalaria*, etc.; Mt. St. Mary's 7500′, in flowers of *Iris*, *Anemothecum*, *Antirrhinum*, *Geranium*, *Verbena*, and different species of roses.

Thrips parvus Schmutz

1913. *Thrips parvus* Schmutz *in* Sitz. Akad. Wiss. Wien. **122**: 1004.
1926. *Thrips parvus* Karny, H. H. *in* Mem. Dep. Agri. Ind., Ent. ser., **6**: 199.
1934. *Thrips florum* Priesner, H. *in* Natur. Tidschr. Neder. Ind. **94** (3): 268-269.

NILGIRIS: Burliar Fruit Research Station 2500′, 2 females on *Bauhinia* flowers, 8-5-1959.

This species is closely related to *Thrips florum* differing from it in the 3rd antennal joint being shorter than the 6th and the upper vein of forewing with 2 distal bristles while in *T. florum* the 3rd antennal joint is as long as 6 and upper vein has 3 distal setae.

Thrips apicatus Priesner

1934. *Thrips apicatus* Priesner, H. *in* Natur. Tidschr. Neder. Ind. **94** (3) : 264.

NILGIRIS: Ootacamund, Raj Bhavan Gardens 7000′, female on knol-kohl leaves, 11-5-1959. KODAIKANAL ; Shembaganur, Sacred Heart College 5500′, numerous females on *Acacia podalyriaefolia* flowers, 5-6-1959.

This species has been hitherto known only from a single female collected on *Acacia* from Guntur and described by Priesner.

Thrips tabaci Lindeman

1888. *Thrips tabaci* Lindeman *in* Die Schadl. Ins. Tabac, 15.

1902. *Thrips tabaci* Hinds, W. E. *in* Proc. U.S. Nat. Museum **26** : 178-194.

1932. *Thrips tabaci* Ramakrishna, T. V. *in* Agr. & Livestk. Ind. **2** (4) : 394-395.

NILGIRIS : Ootacamund, Raj Bhavan Gardens 7000′, numerous males and females on carnations, 11-5-1959. KODAIKANAL : Mt. St. Mary's 7500′, on carnations numerous males and females; also on *Verbena venosa*, *Rosa bankia*, *Osbeckia*, *Agapanthus*, *Iris*, etc., 5-6-1959.

This species has a very wide distribution and is extremely polyphagous. The damage wrought by them to carnations in India has hitherto been unnoticed in spite of the attention it has received as the most harmful injurer in Europe, Britain, and the United States. The damage is evident from the numerous pale and blotched areas on the otherwise continuous beds of red and pink flowers. The flowers become dry and wrinkled and fade owing to heavy infestation. The early signs are the blotching of petals becoming white or silvery and subsequently turning light grey and finally brown. All the parts of the flowers were found to be attacked and several adults and larvae were observed inside each flower.

Thrips nilgiriensis Ramakrishna

1928. *Thrips nilgiriensis* Ramakrishna, T. V. *in* Mem. Dep. Agri. Ind., Ent. ser., (7) **10** : 262-263.

1940. *Thrips nilgiriensis* Ramakrishna, T. V. & Margabandhu, V. *in* Cat. Ind. Insects, pt. 25 : 23.

NILGIRIS : Ootacamund, Raj Bhavan Gardens 7000′, numerous females and males in flowers of broad beans (*Fabia vulgaris*) and flowers of peaches, plums, etc. 11-5-1959. KODAIKANAL : Shembaganur, Sacred

Heart College 5500′, numerous females in orchid flowers, *Habenaria*, *Cypripedium*, and *Dendrobium gratiosissimum*. Mt. St. Mary's 7500′, on carnations, Avocado inflorescence, Poppy flowers, and Goodlaea flowers, 5-6-1959.

Though an attempt to find the orchid thrips *Chaetanaphothrips orchidii* Moulton proved unsuccessful, the existence in fairly good numbers of *Thrips nilgiriensis* and *Haplothrips gowdeyii* (Franklin) on orchids of different kinds was recorded. *T. nilgiriensis*, from what can be inferred from its host range, seems to be gaining importance as one of the efficient injurers of flowers, especially at altitudes, since so far as known to the author their abundance in the plains is totally negligible. They are yellow forms having close resemblance to *Thrips palmi* Karny from which they are distinguished by the difference in the number of costal bristles, which even if considered to be within the normal range of variations, could be still separated by the position of the four setae on the IX tergite which are equidistant from each other in *palmi* while in *nilgiriensis* the two median setae are twice as wide apart as the lateral one from them.

Thrips bambusae Shumsher

1945. *Thrips bambusae* Shumsher Singh *in* Indian J. Ent. **7** : 182-184.

NILGIRIS : Raj Bhavan Gardens 7000′, numerous males and females on bamboo spindles, 11-5-1959 ; Coonoor, Sims Park 5500′, numerous males and females on bamboo spindles, 10-5-1959. KODAIKANAL : Shembaganur, Sacred Heart College 5500′, numerous males and females on bamboo spindles, 5-6-1959.

Thrips melaneurus Bagnall

1926. *Thrips melaneurus* Bagnall, R. S. *in* A. M. N. H. (9) **17** : 11.

1928. *Thrips melaneurus* Ramakrishna, T. V. *in* Mem. Dep. Agri. Ind., Ent. ser., (7) **10** : 262.

NILGIRIS : Ootacamund, Raj Bhavan Gardens 7000′, numerous females on *Rosa bankia*, 11-5-1959. KODAIKANAL : Mt. St. Mary's 7500′, numerous females and males on different species of rose.

This is a common species of thrips often found in the company of *Thrips florum* inhabiting rose flowers.

Thrips palmi Karny

1925. *Thrips palmi* Karny, H. H. *in* Bull. Deli. Proef. st. **23** : 10.

1926. *Thrips palmi* Karny, H. H. *in* Mem. Dep. Agri. Ind., Ent. ser., (6) **9** : 199.

1947. *Thrips palmi* Shumsher Singh *in* Indian J. Ent. **7** : 171.

NILGIRIS : Ootacamund, Raj Bhavan Gardens 7000′, numerous females on flowers of *Lathyrus*, 11-5-1959.

Heliothrips haemorrhoidalis Bouche

1833. *Heliothrips haemorrhoidalis* Bouche *in* Nat. Schadl. Garten Ins. : 206.

1902. *Heliothrips haemorrhoidalis* Hinds, W. E. *in* Proc. U.S. Nat. Mus. **26** : 168-169.

1940. *Heliothrips haemorrhoidalis* Ramakrishna, T. V. & Margabandhu, V. *in* Cat. Ind. Insects pt. 25 : 11-12.

NILGIRIS : Ootacamund, Botanical Gardens 7000′, 2 females on grass, 11-5-1959 ; Coonoor, Pomological Station 5500′, 5 females on grass, 10-5-1959. KODAIKANAL : Bryant's Park 7000′, numerous females on young pine needles, 6-6-1959.

Helionothrips kadaliphila (Ramakrishna & Margabandhu)

1931. *Heliothrips kadaliphila* Ramakrishna, T. V. & Margabandhu, V. *in* J. Bombay nat. Hist. Soc. **34** (4) : 1033.

1936. *Helionothrips kadaliphila* Priesner, H. *in* Proc. R. Ent. Soc. London (B) **5** : 208.

NILGIRIS : Kallar Fruit Research Station 1500′, numerous females and males on plantain leaves ; Burliar Fruit Research Station 2500′, numerous females and males on *Colocasia* leaves, 8-5-1959.

Caliothrips indicus (Bagnall)

1913. *Heliothrips indicus* Bagnall, R. S. *in* A. M. N. H. (8) **12** : 291.

1934. *Heliothrips indicus* Ramakrishna, T. V. *in* Agr. & Livestk. Ind. **2** (4) : 397.

1940. *Heliothrips indicus* Ramakrishna, T. V. & Margabandhu, V. *in* Cat. Ind. Insects pt. 25 : 12.

1947. *Hercothrips indicus* Shumsher Singh *in* Indian J. Ent. **7** : 175.

NILGIRIS : Coonoor Pomological Research Station, 5500′, 6 females on grass, 10-5-1959.

Suborder TUBULIFERA Haliday

Genus **STICTOTHRIPS** Hood

1924. *Stictothrips* Hood, J. D. *in* Psyche : 295.

Stictothrips fimbriata (Ananthakrishnan)

1953. *Thilakothrips fimbriata* Ananthakrishnan, T. N. *in* Proc. R. Ent. Soc. Lond. (B) **22** (3-4) : 33-34.

NILGIRIS : Coonoor Pomological Station 5500′, 1 female on grass, 10-5-1959.

Genus **HOPLOTHRIPS** Serville

1843. Serville *in* Hist. Nat. Ins. Hem. : 640.
1949. Priesner, H. *in* Bull. Soc. Fouad Ier. Entom. **33** : 86.
1957. Stannard, L. J. *in* Ill. Biol. Mon. (25) : 70-71.

The genus *Hoplothrips* is characterised by the head distinctly longer than broad, fore femora not or slightly enlarged, mouth cone long, sides straight, at least attaining mesosternum and the terminal antennal joints not forming a unit. This genus has hitherto been unrepresented in India. All the same, according to Stannard (1957), the genus *Hoplothrips* is synonymous with *Phlaeothrips* Haliday. However, pending further discussions, the genus is retained as such here.

Hoplothrips indicus sp. nov.

Macropterous female :

General body colour brownish yellow ; head, thorax, all femora except at apex, abdominal segments IV-X and antennal joints 5-8, brown; antennal joints 2 and 3, all tibia, tarsi, and apex of femora yellow ; joint 1, abdominal segments II and III yellow, shaded with brown.

Head 238 μ long, 196 μ across eyes, 182 μ across cheeks, and 168 at base, distinctly constricted at base (Fig. 3 A). Eyes 70 μ long, 75 μ wide at middle. Postoculars dilated, well developed, 64 μ long, placed 16 μ from cheeks. Ocelli placed forward, posterior ocelli beyond middle line of eyes, median ocellus at vertex not very much over-hanging. Median ocellus 19 μ in diameter, placed 13 μ from posterior ocelli, 29 μ apart and 16 μ in diameter. Antenna 8-jointed, joints 5, 6, and 7 pedicellate (Fig. 3 a) ; sense cones long and well developed ; 3^{1+1}; 4^{1+1} ; 5^{1+1} ; 6^{1+1} ; antennal joints length (width) in μ : 48 (38), 64 (32), 80 (32), 83 (35), 69 (32), 64 (32), 54 (29), 32 (18). Mouth cone very long reaching just beyond the base of the prosternum, 224 μ long.

Prothorax 224 μ long at middle, as wide at anterior margin, and 223 μ at base inclusive of coxae. Prothoracic bristles moderately long, dilated. Anteroangulars 43 μ ; postangulars 58 μ ; epimerals 64 μ long. Fore femora moderately enlarged, 112 μ wide at middle, foretarsus with a triangular tooth, 16 μ long and 13 μ wide at base. Wings reaching VI abdominal segment, not constricted at middle.

Abdomen broad at base, uniformly wide across segments II-V, 448 μ ; segment VIII 322 μ wide, IX 154 μ wide; bristles of IX outer ones long and fine, inner short and infundibuliform, 65 μ long. Tube 140 μ long, 84 μ wide at base, 56 at middle and 42 at tip. Anal setae as long as tube. Total body length 2.240 mm.

NILGIRIS : Coonoor Pomological Station 5500′, female on *Lantana* flowers, 10-5-1959.

Bamboosiella bicoloripes Ananthakrishnan

1957. *Bamboosiella bicoloripes* Ananthakrishnan, T. N. *in* Ent. News **68** (3) : 65-68.

The discovery of more males and females of this species from bamboo spindles adds considerably to our knowledge of the range of variations of this form noted particularly for its long and thin sense cones and short mouth cone with short stylets confined only to the mouth cone.

Macropterous female :

Head 238-294 μ long from front margin of eyes, 196-210 μ wide across eyes, 203 across cheeks, and 182 at base. Posterior cheek bristle 19 μ long. Eyes 98-126 μ long, 56-84 μ wide at middle. Median ocellus 19 μ in diameter placed 22 μ from posterior ocelli, 22 μ in diameter and 32 μ apart. Postoculars 64-77 μ long, placed 29-32 μ from cheeks and 22-26 μ from posterior margin of eyes. Antennal joints length (width) in μ : 35-38 (35-38), 51-58 (26-32), 77-83 (26-32), 83-93 (36-32), 70-83 (26-32), 58-70 (26-29), 45-54 (22), 32-35 (13).

Prothorax 168-210 μ long, 168-238 μ wide at anterior margin, and 350 μ at base. Prothoracic setae : anteroangulars 32-45 μ ; midlaterals 35-48 μ ; postangulars 56 μ ; epimerals 58-64 μ long. Pterothorax 294-350 μ long and 378 μ side. Forewings 812-910 μ long ; basal wing bristles, 38 μ, 45-48 μ, and 64-78 μ long.

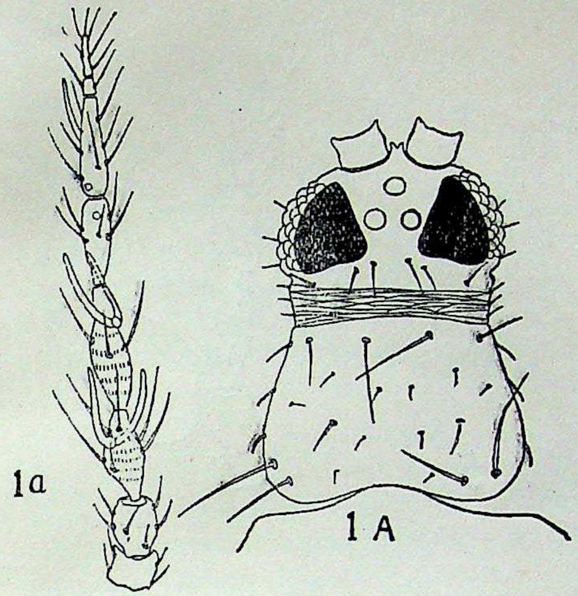
Bristles of abdominal segment IX : outer 173, middle 167, and inner 143 μ long. Tube 168 μ long. Total body length 1.862 to 2.492 mm.

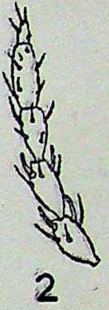
Macropterous male :

Head, length 217-252 μ, 154-182 μ wide across eyes, and 168 at base. Eyes 91-98 μ long and 70 μ wide. Median ocellus 19 μ in diameter, placed 26 μ from posterior ocelli, 19 μ in diameter and 26 μ apart. Postoculars 54-67 μ long placed 16 μ from cheeks and 22 μ from eye margin. Antennal joints length (width) in μ : 26-29 (32), 48-51 (32), 70-77 (29-32), 75-78 (29-32), 63-70 (22-26), 48-51 (22), 45 (19), 32 (13).

Prothorax 168-182 μ long at middle, 182-210 μ wide anteriorly, and 280-308 μ at posterior margin inclusive of coxae. Anteroangulars 29-32 ; epimerals 51-57 μ long. Forewings 770-810 μ long. Bristles of IX : outer 141-144 and inner 160-172 μ long. Tube 140 μ long.

NILGIRIS : Kallar 1500′, 5 females and 3 males on bamboo spindles, 9-5-1959.





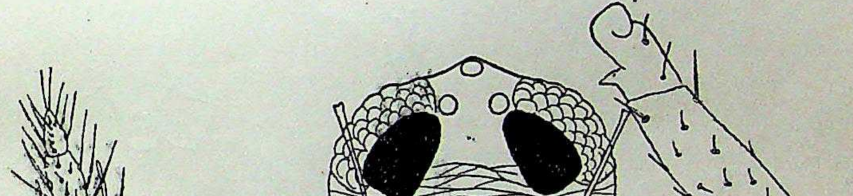
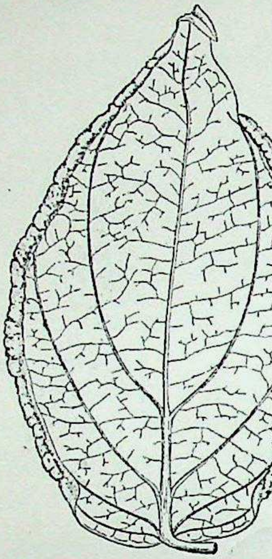


Fig. 1. *Aroidothrips longistylus* sp. n. × 110; 1A. Head and prothorax of female; 1a. Antenna of female. Fig. 2. *Bolacothrips bicolor* sp. n. × 110: Antennal joints 3-7 of female. Fig. 3. *Hoplothrips indicus* sp. n. × 110: 3A. Head, prothorax, and forelegs of female; 3a. Antenna of female.



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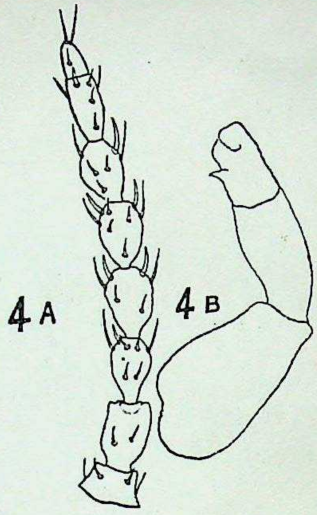

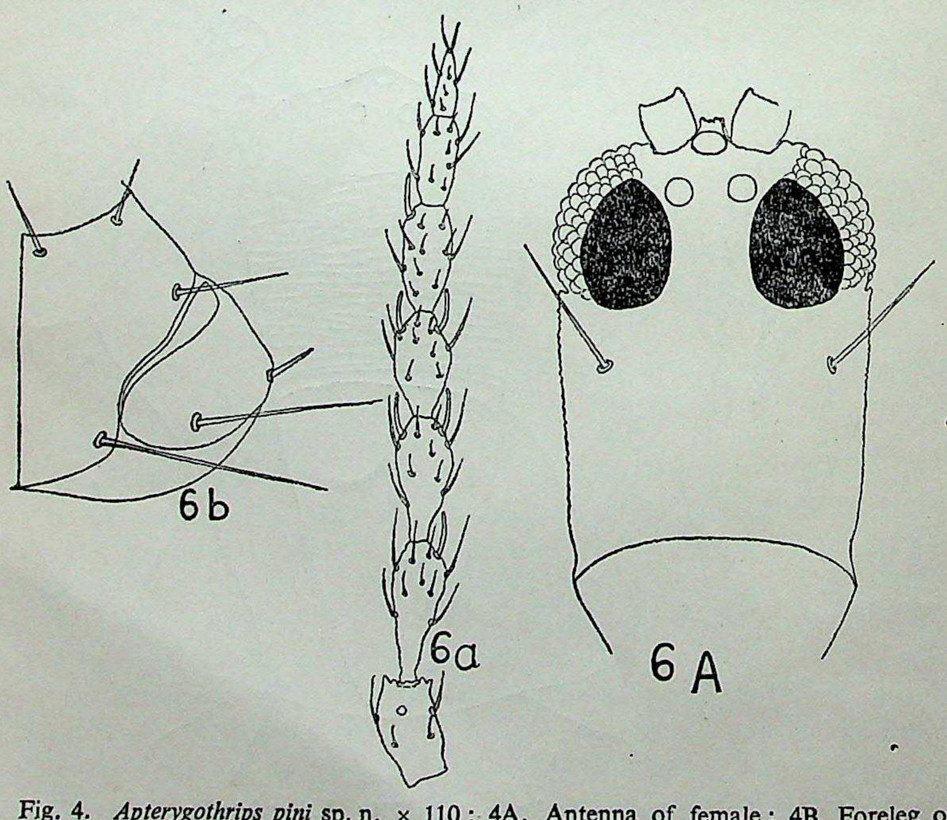

Fig. 4. *Apterygothrips pini* sp. n. × 110: 4A. Antenna of female; 4B. Foreleg of female. Fig. 5. Marginal leaf gall of pepper, formed by *Gynaikothrips karnyi* Bagnall. Fig. 6. *Gynaikothrips karnyi* Bagnall × 110: 6A. Head of female; 6a Antenna of female; 6b. Prothoracic chaetotaxy (one half).

Haplothrips (Trybomiella) ramakrishnai Karny

1926. *Haplothrips ramakrishnai* Karny, H. H. *in* Mem. Dept. Agri. Ind., Ent. ser., **9** (6) : 218.

1928. *Haplothrips ramakrishnai* Ramakrishna, T. V. *in* ibid. (7) : 10 292.

1931. *Haplothrips ramakrishnai* Ramakrishna, T. V. & Margabandhu, V. *in* J. Bombay nat. Hist. Soc. **34** (4) : 1038.

1933. *Haplothrips ramakrishnai* Priesner, H. *in* Rec. Ind. Mus. **25** : 361.

1957. *Haplothrips* (*Trybomiella*) *ramakrishnai* Ananthakrishnan, T. N. *in* Zool. Anz. **159** : 100-101.

KODAIKANAL : 6000′, several males and females on flowers of *Ageratum conizoides*, a very common roadside plant. Mt. St. Mary's 7500′, 10 females and 6 males in flowers of Hollyhock ; 4 females and 2 males of Gerbera inflorescence, 5-6-1959. Bryant's Park 7000′, numerous males and females on Canna leaves, 5-6-1959.

It is of interest to note that only two species of *Trybomiella* are known from India, *T. ramakrishnai* and *T. apicalis* Priesner. *T. apicalis* is a typical grass-infesting form pale yellowish brown to golden brown in colour and head 1.2-1.3 times as long as wide, while *ramakrishnai* has not been recorded from grasses and is pale chestnut brown in colour with head as long as wide. Though *T. tirumalraoi* Ramk. & Marg. has been described from a single male, closer examination will reveal that it is a possible synonym of *ramakrishnai*.

Haplothrips gowdeyii (Franklin)

1908. *Anthothrips gowdeyii* Franklin, H. J. *in* Proc. U.S. Nat. Mus. **33** : 724.

1910. *Anthothrips gowdeyii* Bagnall, R. S. H. *in* Thysanoptera-Fauna Hawaiiensis **3** : 669-701.

1931. *Haplothrips gowdeyii* Priesner, H. *in* Bull. Soc. Roy. Ent. Egypt : 261.

1933. *Haplothrips gowdeyii* Priesner, H. *in* Rec. Ind. Mus. **35** : 354.

1937. *Haplothrips gowdeyii* Sakimura, K. *in* Proc. Haw. Ent. Soc. **9** (3) : 422.

The occurrence of this thrips in considerable numbers on a variety of plants, in particular on orchids and hollyhocks, and the damage it causes to the latter in particular are an addition to our knowledge of the bionomics of this form in India, especially when the only hitherto available data in our country is its record on *Solanum* leaves. It can be ranked as one of the commonest Tubulifera in our country and when one realises its world-wide distribution, having a very wide host range, being extremely common in flowers of different kinds, it is difficult to imagine that its role as a major horticultural pest has been overlooked. Its importance lies in its polyphagous nature, feeding on flowers and leaves, its relative population density, and its ability to breed on most of the plants it infests. Several individuals were found in groups, feeding around the base of the ovary inside the hollyhocks. The infestation proved to be severe in the bud condition.

KODAIKANAL: Mt. St. Mary's 7500′, hollyhock flowers, numerous males and females, 5-6-1959. Bryant's Park 7000′, numerous individuals on leaves of Canna and grass, 5-6-1959.

Haplothrips euphorbiae Priesner

1931. *Haplothrips euphorbiae* Priesner, H. *in* Miscellanea Zoologica Sumatrana **58** : 1-4.

NILGIRIS: Kallar 1500′, several males and females collected on leaves of *Euphorbia hirta*, 8-5-1959.

This species is a new record to India and is responsible for the malformation of the leaves and in extreme cases the leaves become severely damaged.

Xylaplothrips pictipes (Bagnall)

1919. *Haplothrips pictipes* Bagnall, R. S. *in* A. M. N. H. (9) **3** : 273.

1925. *Haplothrips pictipes* Ramakrishna, T. V. *in* J. Bombay nat. Hist. Soc. **30**: 868.

1928. *Haplothrips pictipes* Ramakrishna, T. V. *in* Mem. Dept. Agr. Ind., Ent. ser., (7) 10 : 292.

1933. *Haplothrips pictipes* Priesner, H. *in* Rec. Ind. Mus. **25** (3) : 351.

1938. *Xylaplothrips pictipes* Crawford, J. C. *in* Proc. Ent. Soc. Wash. **40** (2) : 42.

NILGIRIS: Kallar Fruit Research Station 1500′, 4 males and 5 females on cashew inflorescence, 8-5-1959.

Xylaplothrips Priesner has delicate, slender body form and the females of *pictipes* in this collection range between 1.204-1.498 mm. in length and the males from 1.064-1.115 mm. *X. pictipes* (Bagnall) is distinguished from *X. nayari* Ananthakrishnan by the presence of the foretarsal tooth in both the sexes.

Dolichothrips (Dolicholepta) rambhutanae sp. nov.

Macropterous female :

General colour brown ; all tarsi, foretibia except at base, antennal joints 2-7 yellow ; rest of body brown. Wings colourless, Head, 210-224 μ long, 168 μ wide across eyes and 154 at base, distinctly constricted at base and 1.3 times as long as wide across cheeks. Eyes 98 μ long and 70 μ wide. Ocelli well developed, median ocellus overhanging vertex, 16 μ in diameter, placed 19 μ from posterior ocelli 22 μ apart and 16 μ in diameter. Postoculars 48 μ long and blunt at tip. Antennal joints length (width) in μ : 29-32 (32), 48-51 (32), 61-64 (29-32), 64-70 (32), 54-58 (29), 48-51 (26), 45-48 (22), 26 (13). Mouth cone 182 μ long, 126 μ wide at base, 56 at middle, and 28 μ at tip, sides biconcave and tip reaching the base of prosternum. Maxillary palpi 64 μ long and labial palpi 19 μ long.

Prothorax 182-210 μ long at middle, 162-168 μ wide across anterior margin, and 266-308 μ wide at base inclusive of coxae. Prothoracic bristles, short and dilated at tip. Anteroangulars 26 μ, postangulars 32 μ, epimerals 38 μ long. Forefemora 84 μ wide at middle, foretarsus with a small, inconspicuous tooth.

Pterothorax 350 μ long and 336 μ wide at middle. Wings clear, constricted at middle, reaching VII abdominal segment with 8 duplicate cilia. Bristles on scales 42, 38, and 51 μ long respectively.

Abdomen broad at base, 322 μ wide, 280 μ wide across segment IV, 266, 224, and 112 μ wide across segments VII, VIII, and IX. All the 3 bristles of segment IX subequal, 150 μ long. Tube 168 μ long, 70, 56, and 42 μ wide at base, middle, and apex respectively ; anal setae long and fine, longer than tube, 210 μ long.

Total body length 1.904-2.324 mm.

Macropterous male :

Head 224 μ long, 154 μ wide across cheeks, and 133 μ wide at base. Eyes 84 μ long and 63 μ wide. Postoculars 48 μ long. Median ocellus 13 μ in diameter, placed 16 μ from posterior ocelli, 16 μ in diameter and 29 μ apart. Antennal joints length (width) in μ : 22 (29), 45 (26), 67 (29), 67 (29), 58 (26), 54 (22), 48 (16), 29 (10). Mouth cone 98 μ wide at base and 28 μ wide at tip.

Prothorax 196 μ long at middle, 140 μ wide at anterior margin, and 280 μ wide at posterior margin. Anteroangulars 19 μ, postangulars 43, and epimerals 35 μ long. Forefemora 84 μ wide at middle with foretarsal tooth slightly more developed than in the female.

Pterothorax 294 μ wide and 308 μ long at middle. Wing scale bristles 43, 38, and 51 μ long respectively.

Abdomen long and thin, 224, 182, 126, and 98 μ wide at base, at middle, and across VIII and IX abdominal segments respectively. Bristles of IX subequal, 128 μ long. Tube 168 μ long, 56 μ wide at base ; anal setae 224 μ long.

NILGIRIS : Kallar Fruit Research Station 1500′, 13 females and 3 males on inflorescence of Rambhutan, 9-5-1959.

Praepodothrips indicus Priesner & Seshadri

1952. *Praepodothrips indicus* Priesner, H. & Seshadri, A.R. *in* Ind. Jour. Agri. Res. **22** (2) : 408-409.

KODAIKANAL : Perumalmalai Hills 5000′, 4 females from sheaths of wild grass, 4-6-1959. NILGIRIS : Coonoor Pomological Station 5500′, one female on perennial rye grass, 10-5-1959.

A typical grass-inhabiting form, this species is represented only in India and shows a distinct tendency towards oedymerism.

Praepodothrips priesneri Ananthakrishnan

1955. *Praepodothrips priesneri* Ananthakrishnan, T. N. *in* A. M. N. H. **12** (3) : 608.

NILGIRIS : Coonoor, Sim's Park 5500′, 2 females on bamboo spindles, 10-5-1959.

This is a typical bamboo leaf and sheath infesting form, purely monophagous whether it be on the plains or hills.

Praepodothrips cymbopogoni Ananthakrishnan

1957. *Praepodothrips cymbapogoni* [*sic*] Ananthakrishnan, T. N. *in* Zool. Anz. 157 : 136-138.

NILGIRIS : Coonoor Pomological Station 5500′, several females and males inside the leafsheath of lemon grass, *Cymbopogon citratus*, 10-5-1959.

It is of interest to note that, of the three species of *Praepodothrips*, *priesneri* and *cymbopogoni* are monophagous while *indicus* has been seen to feed on different kinds of grasses.

Genus **APTERYGOTHRIPS** Priesner

1933. Priesner, H. *in* Bull. Soc. Roy. Ent. Egypte : 1-3.

Body very small, wings and ocelli absent. Joint 3 of antenna short, broad at apex. Prothorax broader and shorter than head. Pterothorax narrower than prothorax including coxae. Forefemora little enlarged in the male, without teeth ; foretarsi with a distinct tooth in both the sexes, shape as in *Karnyothrips*. Tube very short, conical.

Apterygothrips pini sp. nov.

Female :

General body colour brown with yellow pigment. Antennal joints 1-2, 7-8 more brownish yellow ; joints 3-6 yellowish brown. Tube except at apex yellow. Body with scattered red pigment. Abdominal segments with more of yellow suffused with brown.

Head 147-154 μ long from eye margin, 140 μ wide across eyes, and 140-147 μ wide across cheeks. Eyes 48 μ long, 45 μ wide at middle,being 51 μ wide at interocular region. Postoculars 35-38 μ long, slightly dilated at apex. Antenna 8-jointed (Fig. 4A), joint 3 short, with a pedicel and with one small sense cone. Antennal joints length (width) in μ: 32 (29), 45 (29), 35-38 (22), 38-43 (29), 43 (26), 38-41 (26), 43 (22), 26-29 (13). Mouth cone 98 μ long reaching just the hind margin of the prosternum, blunt.

Prothorax 140 μ long at middle, shorter than head, 168 μ wide across anterior margin, and 224 μ at base inclusive of coxae. Prothoracic bristles short, dilated at tip. Anteroangulars 16 μ ; postangulars 29 ; epimerals 38 and coxals 19 μ long. Pterothorax 168 μ long, 172 μ wide. Forefemora moderately enlarged, 70 μ wide, foretarsus with small tooth (Fig. 4B).

Abdomen 224 μ wide at base, 308 μ wide across segments V and VI, 140 across VIII, and 126 across IX segment. Setae on IX short and fine ; outer 35-48, middle 26-32, and inner 48-60 μ long. Tube 83-90 μ long, 60 μ wide at base, 43 at middle, and 32 at tip ; anal setae 80 μ long.

Total body length 1.26-1.41 mm.

Male :

General colour as in the female, more brownish. Head, thorax, and legs darker brown, as also antennal joints 3-6.

Head 140 μ long, 126 μ wide across eyes. Eyes 45-48 μ long and as wide. Postangulars 29 μ long. Antennal joints, length (width) in μ : 29 (26), 44 (26), 38 (22), 43 (26), 43 (26), 35 (22), the last two joints missing. Prothorax 126 μ wide at anterior margin, 196 at posterior margin, and 140 μ long at middle. Prothoracic bristles : anteroangulars 16 μ long ; postangulars 29 ; epimerals 35 ; coxals 19 μ long. Forefemora not enlarged, 56 μ wide at middle, foretarsi with a small tooth.

Abdomen at base 196 μ wide, 98 μ across segment IX. Setae of IX: outer 45, middle 26, inner 51 μ long. Tube 86 μ long, 54 μ wide at base, 38 at middle, 29 at tip.

Total body length 1.218 mm.

KODAIKANAL : Bryant's Park 7000′, 3 females and 2 males on pine needles, 4-6-1959.

Only four species of this genus have hitherto been known, *haloxyli* Priesner, *luteus* Faure, *carolinae* Faure, and *flavus* Faure. *A. pini* is very closely allied to *A. haloxyli* but is easily distinguishable by the difference in the chaetotaxy of the body and in the dilated pronotal bristles.

Gynaikothrips karnyi Bagnall

1914. *Gynaikothrips karnyi* Bagnall, R. S. *in* A. M. N. H. **13** : 23-31.

1952. *Gynaikothrips karnyi* Ananthakrishnan, T. N. *in* Indian J. Ent. **14** : 201.

Except for a casual reference to the record of 2 females by Ananthakrishnan (1952) nothing has been known about this interesting gall making thrips from India. The original reference to this species by Bagnall from leaf galls on pepper (Fig. 5) from Ceylon does not comply with modern concepts, particularly in the absence of any mention of the prothoracic chaetotaxy (Fig. 6b) especially the postangulars and the epimerals. Further, no mention is made of the sex described and, from a comparison of the several individuals at the disposal of the author, what Bagnall described appears to be a male, since the range of body length of the males in the author's collection tallies with that of Bagnall's specimen.

Macropterous female :

Total body length 2.59-2.80 mm. Head, length 280-308 μ, width across cheeks 210-224 μ. Postoculars 89-96 μ. Eyes, length 112 μ, width 84 μ. Antennal joints, length (width) μ : 48-54 (48), 64-70 (35-38), 83-93 (32), 77-86 (38), 74-80 (35), 74-83 (32-35), 64-67 (29), 45-48 (16).

Prothorax, length 196 μ, width at anterior margin 280 μ, at posterior margin 448 μ. Prothoracic bristles : anteroangulars 42-48 μ; anteromarginals 58-64 μ ; midlateral 109 μ ; postangulars 147-153 μ ; epimeral 128-144 μ long.

Pterothorax, length 448 μ ; width at base 462 μ ; at middle 490 μ. Forewings, length 952-1008 μ, 98-126 μ wide at base, 84-98 μ at middle, and 70-84 μ at tip. Tube 210-232 μ long.

Male :

Total body length 1.92-2.18 mm. Head, length 266-280 μ ; width 196-203 μ. Postoculars 77-90 μ. Antennal joints, length (width) μ : 48-52 (43), 58-61 (32), 77-80 (32), 67-70 (32-35), 70-73 (32), 70 (29-32), 60 (26), 43 (13).

Prothorax, length 154 μ ; width at anterior margin 238 μ, at posterior margin 350 μ. Prothoracic bristles ; anteroangulars 35-38 μ, anteromarginals 45-48 μ ; midlaterals 86-92 μ. Postangulars 144 μ ; epimerals 128-134 μ. Pterothorax, length 350 μ, width 378 μ. Forewings length 994 μ ; 84, 70, and 70 μ wide at base, middle and tip. Tube length 172 μ.

NILGIRIS : Kallar 1400′, Burliar 2500′, numerous males and females from marginal leaf galls of pepper.

Gynaikothrips interlocatus Karny

1926. *Gynaikothrips interlocatus*, Karny, H. H. *in* Mem. Dept. Agr. Ind., Ent. ser., (6) **9** : 237-238.

NILGIRIS : Burliar 2500′, female on leaf of wild plant, 8-5-1959.

Cercothrips tibialis (Bagnall)

1921. *Gynaikothrips tibialis* Bagnall, R. S. *in* A. M. N. H. **7** (9) : 264-265.
1926. *Gynaikothrips tibialis* Karny, H. H. *in* Mem. Dept. Agr. Ind., Ent. ser., **9** : 239.
1934. *Cercothrips tibialis* Ramakrishna, T. V. *in* Rec. Ind. Mus. **36** : 498.

NILGIRIS : Kallar 1400′, numerous males and females on *Ficus bengalensis*, 8-5-1959.

LIST OF SPECIES OF THRIPS COMMON ON SOME OF THE ORNAMENTAL PLANTS OF OOTACAMUND AND KODAIKANAL HILLS

Host Plant	Name of Species
Agapanthus	*Thrips tabaci* Lind. *Thrips florum* Schmutz *Frankliniella sulphurea* Schmutz
Anemothecum	*Thrips melaneurus* Bagnall *Thrips florum* Schmutz
Antirrhinum	*Thrips florum* Schmutz
Canna	*Haplothrips* (*Trybomiella*) *ramakrishnai* Karny *Haplothrips gowdeyii* (Franklin)
Coreopsis	*Haplothrips* (*Trybomiella*) *ramakrishnai* Karny *Thrips tabaci* Lind.
Carnations	*Thrips tabaci* Lind. *Taeniothrips simplex* (Morrison) *Frankliniella sulphurea* Schmutz
Coelogyne	*Haplothrips gowdeyii* (Franklin)
Cymbidium bicolor	*Heliothrips haemorrhoidalis* Bouche *Haplothrips gowdeyii* (Franklin)
Delphinium	*Thrips tabaci* Lind. *Thrips florum* Schmutz
Dendrobium sp.	*Haplothrips gowdeyii* (Franklin)
Fabia vulgaris	*Thrips nilgiriensis* Ramakrishna

Geranium	*Thrips florum* Schmutz *Heliothrips haemorrhoidalis* Bouche
Gladiolus	*Taeniothrips simplex* (Morrison)
Goodlaea	*Xylaplothrips pictipes* Bagnall *Thrips nilgiriensis* Ramakrishna
Habenaria	*Thrips nilgiriensis* Ramakrishna
Hollyhock	*Haplothrips gowdeyii* (Franklin) *Haplothrips* (*Trybomiella*) *ramakrishnai* Karny
Iris	*Thrips tabaci* Lind. *Thrips florum* Schmutz *Frankliniella sulphurea* Schmutz *Heliothrips haemorrhoidalis* Bouche *Taeniothrips simplex* (Morrison)
Lathyrus sp.	*Thrips nilgiriensis* Ramakrishna
Limonium	*Thrips florum* Schmutz
Osbeckia	*Thrips tabaci* Lind.
Phlox sp.	*Thrips florum* Schmutz
Richardia sp.	*Haplothrips gowdeyii* (Franklin) *Heliothrips haemorrhoidalis* Bouche *Thrips florum* Schmutz
Rosa bankia	*Thrips tabaci* Lind. *Thrips melaneurus* Bagnall *Thrips florum* Schmutz
Rosa leschenaultii	*Thrips palmi* Karny *Thrips florum* Schmutz
Rosa multiflora	*Thrips tabaci* Lind.
Salvia sp.	*Thrips florum* Schmutz *Thrips tabaci* Lind.
Saponaria	*Thrips florum* Schmutz
Verbena venosa	*Thrips florum* Schmutz *Thrips tabaci* Lind.

A Systematic and Ecological account of the Cyanophyceae of Hoshiarpur

BY

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(*With twelve figures*)

The study of blue-green algae has been quite neglected in the Panjab as very few workers have ventured to study the cyanophycean flora of this region. Ghose (1919, 1923) was the pioneer worker who made an extensive study of the blue-green algae of Lahore (now in Pakistan) and Simla. After Ghose, Randhawa (1936) contributed to our knowledge of this group. Gupta (1950) has also contributed to the algal flora of Khajar-Chamba State. Apart from the publications of these authors no other work on the Cyanophyceae of the Panjab has appeared.

With a view to explore the cyanophycean flora of the Panjab the author started making extensive collections of these forms from district Hoshiarpur and its vicinity in the year 1958. Since then a systematic study of the material collected is being made and the author is now in a position to publish accounts of the material collected. The present paper incorporates descriptions and records of the blue-green algae from a part of the collection of the author. Future papers in this series will include systematic accounts of further instalments of Cyanophyceae from Hoshiarpur. Further collections are still being made and some of the material has revealed new and very interesting species.

District Hoshiarpur is situated between the rivers Sutlej and Beas and contains a chain of ponds and *choes*. The *choes* are seasonal torrential streams which sweep down the plains during the rainy season and have a large number of *chhambs* or swamps situated by their sides. These *chhambs* are annually replenished by the water of the *choes*. In addition there are a large number of tanks and water reservoirs which afford unique opportunities for algal collection. The large number of temporary and semi-permanent ponds and ditches, situated by the sides of the railway track and the roads, contain an immense wealth of algae during and a little after the monsoons.

Hoshiarpur is a sub-mountainous district of the Jullundhur division comprising so much of the Siwalik Range as lies between latitude 32° 5′

and 30° 58′ north, and longitude 76° 41′ and 75° 31′ east. Its elevation is about 1050 feet (320 m.) above sea-level. The average rainfall is 36″ (914 mm.) of which 30″ (762 mm.) are recorded in the months of July to September and the remaining 6″ (152 mm.) in the winter months. The hottest months are May and June, with a mean maximum temperature of 106° F. (41° C.). The mean minimum temperature is 40°F. (4.4° C.) in the months of December and January.

The Cyanophyceae can be collected throughout the year but they are met with in great abundance during the months of September to April. They are at their height of vegetative activity from September to February. Specimens collected from February to April show an extensive spore formation. Some forms like *Nodularia spumigena* Mertens, *Aulosira fertilissima* var. *tenuis* Rao, *Gloeotrichia raciborskii* Wol., *Cylindrospermum musicola* Kütz., and *C. alatosporum* Fritsch have been observed in sporulation during the months of November and December.

With regard to habitat, the Hoshiarpur Cyanophyceae described herein may be easily separated into the following ecological groups :

I. AQUATIC FORMS : This includes forms that are encountered strictly in water. The aquatic forms fall into two distinct habitat groups :

(i) FLOWING WATERS : Cyanophyceae growing in such habitats are always attached to the substratum, to which they stick by secreting a cement-like material. *Nostoc verrucosum* Vauch. forms extensive olive-coloured strata on the rocky beds of rapidly flowing streams.

(ii) STAGNANT WATERS : To this category belong a large number of Cyanophyceae that can be discussed under the following sub-headings :

(a) *Planktonic or free-floating forms :* These include a large number of tiny unicellular and colonial forms, and filamentous Cyanophyceae that may float on the surface of water in the form of mucilaginous, gelatinous, papery, or woolly strata.

Microcystis aeruginosa Kütz. forms the so-called 'water bloom' of dull green colour in quiet waters of most of the permanent and semi-permanent ponds. Since it occurs in considerable numbers and occupies the whole surface of water, it may be grouped under the Baltic type of algal plankton. *Aphanothece microscopica* Nag. was found forming small sub-globose or amorphous colonies floating on the surface of the water in a permanent pond and can be classified under the Caledonian type of algal plankton. The above two species have their colonial masses flattened and this gives sufficient buoyancy to keep them afloat.

Anabaena mehrai sp. nov. and *Cylindrospermum distinctum* sp. nov. are free-floating in ponds and ditches ; although these species possess single trichomes, the presence of gas vacuoles affords them the necessary buoyancy to keep them afloat.

Lyngbya spiralis Geitler is free-floating mixed with other algae. *Cylindrospermum musicola* Kütz. occurs in the form of flocculent free-floating masses of mucilaginous consistency and is usually mixed with other algae.

Aulosira prolifica Bharad., *Anabaena oscillarioides* var. *crassa* var. nov., and *A. iyengarii* var. *tenuis* Rao form gelatinous free-floating masses near the banks of ponds and other natural water reservoirs.

(b) *Benthic forms :* These are blue-green algae growing fixed to the bottom of ponds, lakes, and streams, or attached to vegetation or other objects in the water. *Lyngbya gardneri* Geitler forms yellowish green tufts at the bottom of many ponds ; this species is attached to the substratum by means of a lower or a basal cell which becomes basally flattened and discoid. *Lyngbya perelegans* Lemm. forms an abundant blue-green microscopic vegetation on soil at the bottom of ponds ; it has no special organs of attachment and forms prostrate or semi-erect masses of filaments which can easily be swept from one place to another by even a slight disturbance in the water.

Oscillatoria claricentrosa forma *bigranulata* Rao grows along walls of *pukka* tanks and is mixed with other species of the same genus. *Nostoc linckia* Born. has also been encountered from the sides of a *pukka* drain.

Anabaena vaginicola Fritsch et Rich. usually grows attached to other submerged water plants.

II. AMPHIBIOUS FORMS : There are a number of species that are abundant and thrive both on moist soil (sub-aerial habitat) and in stagnant waters (aquatic habitat). Such forms may be recorded as amphibious blue-green algae. *Cylindrospermum musicola* Kütz., *C. alatosporum* Fritsch, and *Nostoc ellipsosporum* Rabenh. can easily be referred to this group, and may be treated as amphibious blue-green algae that show a tendency towards sub-aerial habitat.

III. AERIAL FORMS : Cyanophyceae included under this heading grow mainly upon the bark and leaves of trees, and upon stones and walls. *Lyngbya palmarum* Brühl et Biswas has been found in abundance on trunks of palm trees. During the rainy season it forms an extensive, dark-coloured growth, but during the dry months of the year the colour of the thallus becomes yellowish or pale green. A substantial number of the species of *Scytonema* grow on the *pukka* walls of houses and on rocks.

IV. SUB-AERIAL FORMS : The blue-green algae referred to this group grow mainly upon moist soil in patches. *Cylindrospermum musicola* Kütz., *C. alatosporum* Fritsch, *Nostoc ellipsosporum* Rabenh., and *Lyngbya allorgei* Frémy are some of the common forms that can be found growing on moist soils. Several species of *Phormidium*, *Microcoleus*, *Scytonema*, and *Tolypothrix* can be included under this heading. Species of *Phor-*

midium form yellowish brown to blue-green strata that sometimes cover extensive areas. Species of *Scytonema* grow in black patches on moist soil.

The present paper records 25 species belonging to ten genera. Two new species and one new variety have been described. *Anabaena vaginicola* Fritsch et Rich. has been reported for the first time from India.

SYSTEMATIC ENUMERATION OF THE SPECIES OBSERVED

Order CHROOCOCCALES Wettstein

Family CHROOCOCCACEAE Nageli

MICROCYSTIS Kützing

1. **Microcystis aeruginosa** Kütz. Tab. Phycol. 1 : 8, pl. 8, fig. 1, 1846 ; Geitler in Rabenh. Kryptogam. Europa 14 : 136 ; fig. 59d, 1930-32 ; Crow in New Phytol. 22 : pl. 1, fig. a, 1923 ; Frémy, Myxo. Afr. Equat. Franc. 18, fig. 15, 1929 ; Tilden, Minnesota Algae 1 : pl. 2, figs. 21 & 22, 1910 ; Frémy, Cyano. Cotes Eur. 10, pl. 1, fig. 6, 1933. *Clathrocystis aeruginosa* (Kütz.) Henfry, J. Roy. micr. Soc. 53 : pl. 4, figs. 28-36, 1856 ; Forti in De Toni, Syll. Alg. 5 : 94, 1907. *Anacystis cyanea* (Kütz.) Drout & Daily, Rev. Coccoid Myxophy. 36, 1956, pro parte, incl. var. *major* (Wittr.) Smith, et al. vars. & formis *M. aeruginosae*.

Cell diameter=3.8-5.7 μ.

Habitat : Forming a dirty green scum on the surface of quiet stagnant water of permanent and semi-permanent ponds, Hoshiarpur.

GLOEOTHECE Näg.

2. **Gloeothece rupestris** (Lyngb.) Bornet in Mem. Soc. Sci. Nat. Math. Cherbourg 28 : 177, 1892 ; Forti 5 : 63, 1907 ; Frémy 52, fig. 61, 1929 ; Geitler 221, 1932.

Lat. cell without envelope=3.6-6 μ, lat. cell with envelope=7.6-13.6 μ ; long. cell=6.8-15.3 μ ; diam. colony=23-42.5 μ.

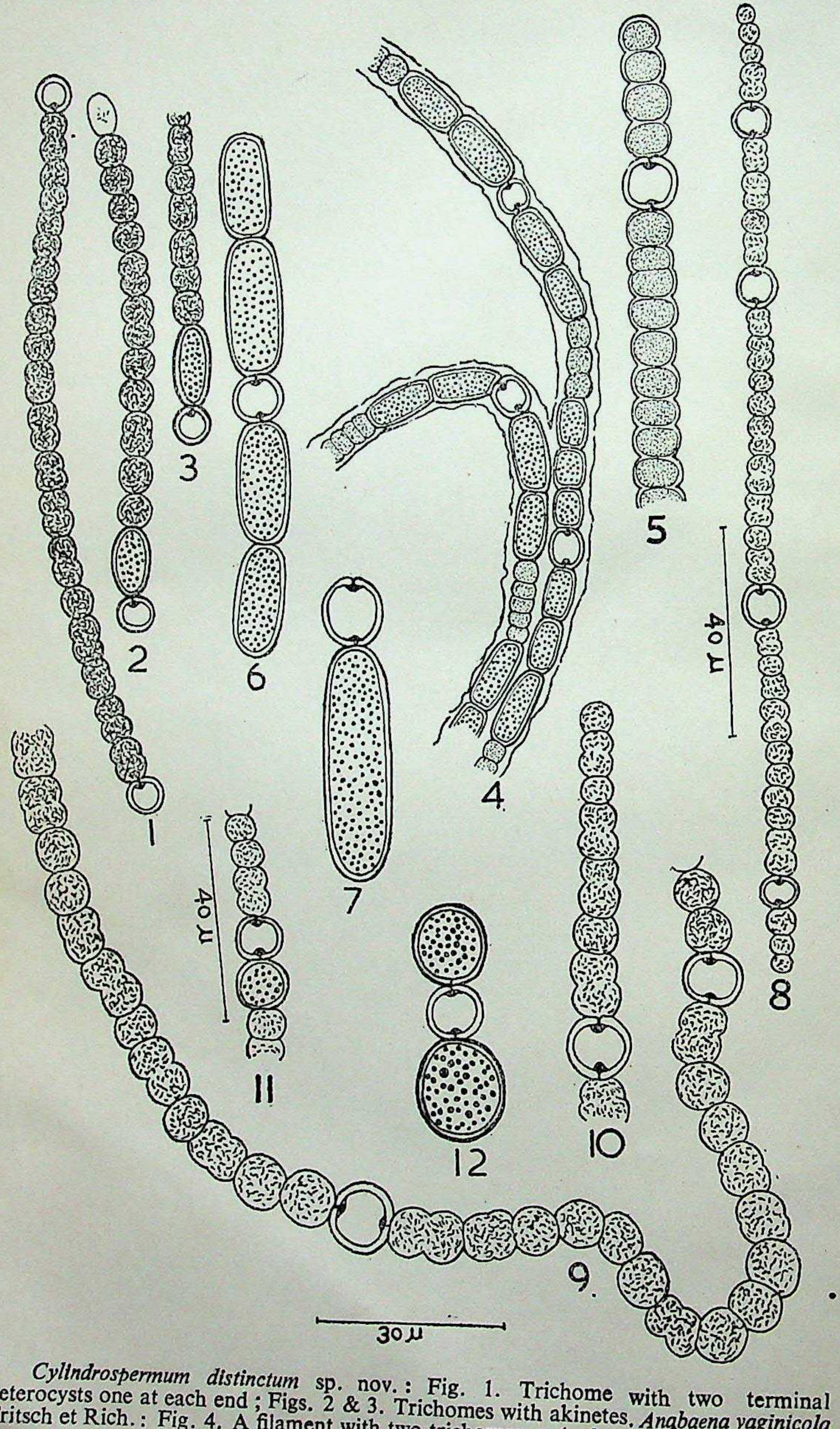
Habitat : On moist soil, Hoshiarpur.

APHANOTHECE Näg.

3. **Aphanothece microscopica** Näg. Gatt. Einzell. Algen 59, pl. 1 H, 1849 ; Forti 5 : 83, 1907 ; Frémy 28, fig. 30, 1929 ; Geitler 172, fig. 79, 1932.

Lat. cell=4-5.1 μ ; long. cell=6.1-8.5 μ.

Habitat : Free-floating in a permanent pond at village Nasrala, Hoshiarpur.



Cylindrospermum distinctum sp. nov.: Fig. 1. Trichome with two terminal heterocysts one at each end; Figs. 2 & 3. Trichomes with akinetes. *Anabaena vaginicola* Fritsch et Rich.: Fig. 4. A filament with two trichomes. *Anabaena vaginicola crassa* var. nov.: Fig. 5. A portion of the trichome with end cell; Figs. 6 & 7. *Anabaena oscillarioides* var. Sporiferous portions of the trichome. *Anabaena mehrai* sp. nov.: Fig. 8. A young trichome with attenuated ends; Fig. 9. Portion of an irregularly curved trichome; Fig. 10. Portion of a trichome with rounded end cell; Fig. 11. Part of a trichome showing only one spore situated one side of the heterocyst; Fig. 12. Portion of a sporiferous trichome showing one spore on either side of the heterocyst.

Order NOSTOCALES Geitler

Family NOSTOCACEAE Kützing

Subfamily ANABAENOIDEAE Born. et Flah.

CYLINDROSPERMUM Kützing

4. **Cylindrospermum alatosporum** Fritsch in Ann. South Afr. Mus. 9 : 587, fig. 37, d, h, 1918 ; Geitler 817, fig. 521, 1932.

Lat. cell=3.4-4.2 μ ; long. cell=3.4-5.1 μ ; lat. heterocyst=5.1-5.9 μ, long. heterocyst=5.9-8.5 μ ; lat. spore with outer wall=8.5-11.9 μ, long. spore=20.4-28.9 μ.

Habitat : Forming dark blue-green mucilaginous growth on moist soil by the side of a water-course at village Purhiran, Hoshiarpur.

5. **Cylindrospermum musicola** Kütz. ex Born. et Flah. in Kützing, Phyc. Germ. 173, 1845 ; Tab. Phycol. 1 : 53, pl. 98, fig. 1, 1849 ; Bornet et Flahault, Rev. Nostoc. Hétéroc. 254, 1888 ; Forti 5 : 477, 1907 ; Frémy 376, fig. 313, 1929 ; Geitler 822, fig. 520 d, 1932.

var. **longispora** Dixit in Proc. Indian Acad. Sci. B 3 : 100, fig. 3 A, B, 1936.

Lat. cell=3-4 μ ; long. cell=3.8-7.6 μ ; lat. heterocyst=4.7-5.7 μ ; long. heterocyst=5.7-9.6 μ ; lat. spore=5.7-11.5 μ ; long. spore=13.1-30.6 μ.

Habitat : In stagnant water of a roadside ditch ; on moist soil, Hoshiarpur.

6. **Cylindrospermum distinctum** sp. nov. (Figs. 1-3).

Trichomes single, straight, rarely curved, blue-green, with distinct constrictions at the septa ; cells spherical to barrel-shaped, as long as broad, pseudovacuoles present ; heterocysts spherical ; akinetes ellipsoidal, always present contiguous to the heterocysts, outer wall hyaline.

Trichomata singula, recta, raro curvata, caeruleo-viridia, constricta ad septa ; cellulae sphaericae vel doliiformes, aeque longae ac latae, pseudovacuola adsunt ; heterocysta sphaerica ; akinetes ellipsoidei, semper adsunt contigui heterocystis ; parietibus exterioribus hyalinis. Typus positus in P. U. College, Hoshiarpur, sub numero *Vasishta* 4328.

Lat. trichome=3.7-5.7 μ ; long. cell=3.7-5.7 μ ; diameter heterocyst=7.5 μ ; lat. spore=7.5-10.5 μ ; long. spore=11.2-16.7 μ.

Habitat : Free-floating in the stagnant water of a pond, Phagwara Road, Hoshiarpur, 25.2.60.

This species comes close to *Cylindrospermum indicum* Rao in possessing (a) free-floating trichomes that occur singly, and (b) ellipsoidal spores ; but differs in (a) the shape and dimensions of cells, (b) presence of pseudovacuoles in the cells, (c) broader heterocysts, and (d) spores without a special outer membrane and smaller in dimensions.

This species stands distinct from all the existing species of the genus in possessing free-floating trichomes that occur singly and do not form a plant mass or thallus and in possessing cells that are packed with pseudovacuoles.

The type specimen is deposited (in the form of camera lucida drawings) in the herbarium of Punjab University College, Hoshiarpur, *Vasishta* 4328.

NOSTOC Vaucher

7. **Nostoc punctiforme** (Kütz.) Hariot, Journ. Bot. 5 : 31, 1891 ; Forti 388, 1907 ; Frémy 331, fig. 274, 1929 ; Geitler 834, 1932. *Nostoc hederulae* Meneghini in Kützing, Sp. Alg. 287, 1849 ; Born. et Flah., op. cit. 189, 1888.

Lat. cell=3-4 μ ; long. cell=3-6 μ ; diameter heterocyst=4.5-6 μ ; lat. spore=4.6-6.5 μ ; long. spore=4.6-8 μ.

Habitat : In culture of crop field soil from village Purhiran, Hoshiarpur.

8. **Nostoc linckia** (Roth.) Bornet ex Born. et Flah. in Bornet et Thuret, Not. Algol. II, 86, pl. 18, figs. 1-12, 1880 ; Born. et Flah. 192, 1888 ; Frémy 332, fig. 276, 1929 ; Geitler 838, fig. 5286, 1932.

Lat. cell=3.8-5.7 μ ; long. cell=3.8-5.7 μ ; diameter heterocyst= 7.6 μ ; lat. spore=6-7.6 μ ; long. spore=7.6-8 μ.

Habitat : On the sides of a *pukka* drain, District Board, Hoshiarpur.

9. **Nostoc verrucosum** Vaucher ex Born. et Flah. in Vaucher, Hist. Conf. Eau Douce 225, pl. 16, fig. 3, 1803 ; Born. et Flah. 216, 1888 ; Forti 5 : 419, 1907 ; Frémy 350, fig. 290, 1929 ; Geitler 854, figs, 43, 542 et 543, 1932.

Lat. cell=3.8-4 μ ; long. cell=3-3.8 μ ; lat. heterocyst=5.7-7.6 μ ; long. heterocyst=6-8.5 μ ; lat. spore=4.7-5.7 μ ; long. spore=5.7-7.6 μ.

Habitat : On the rocky bed of a stream at Bharwain, Hoshiarpur.

10. **Nostoc ellipsosporum** (Desm.) Rabenh., Fl. Eur. Alg. 2 : 169, 1865 ; Bornet et Thuret 2 : 94, pl. 27, figs. 7-11, 1880 ; Born. et Flah. 198, 1888 ; Geitler 841, fig. 533, 1932.

Lat. cell=3.8-4 μ ; long. cell=4-11.5 μ ; lat. heterocyst=4-7.6 μ ; long. heterocyst=7.6-11.5 μ ; lat. spore=5.7-7.6 μ ; long. spore=8.5-12 μ.

Habitat : On the moist soil of a crop field ; in stagnant water of a roadside ditch, Hoshiarpur.

ANABAENA Bory

11. **Anabaena vaginicola** Fritsch et Rich. in Trans. Roy. Soc. S. Afr. 18 : 87, 1929. *Anabaenothrix vaginicola* (Fritsch et Rich.) Ghose et Randhawa in Proc. Indian Acad. Sci. B 3 : 407, 1936. (Fig. 4).

Trichomes single or many in a common mucilaginous sheath, more or less parallel, attached to other plants ; sheath diffluent, colourless, with a rough outline ; trichomes straight or slightly bent, shining blue-green, constricted at the joints ; cells sub-quadrate, sometimes cylindrical, contents blue-green and granular ; apical cell conical with pointed apex ; heterocysts cylindrical or barrel-shaped, slightly flattened at the apices, sometimes become crushed by the pressure of the developing spores, occurring at irregular intervals ; spores short cylindrical or oblong, ends flattened or rounded, contiguous with the heterocysts, often two to four in series, wall hyaline, smooth.

Lat. filament with one trichome=7.5-11.2 μ ; lat. filament with two trichomes=15 μ ; filament with more than two trichomes up to 21 μ broad ; lat. trichome=4-5.6 μ ; long. cell=3.7-4.6 μ ; lat. heterocyst=4.6-5.6 μ ; long. heterocyst=4.6-8 μ ; lat. spore=7.5-11.2 μ ; long. spore =7.5-18.5 μ.

Habitat : Attached to submerged plants in a roadside pond, Phagwara Road, Hoshiarpur.

12. **Anabaena iyengarii** Bharad. in Proc. Indian Acad. Sci. B 2 : 105, fig. 6 H-K, 1935. var. **tenuis** Rao in Proc. Indian Acad. Sci. B 6 : 361, fig. 5 A-C, 1937 b.

Lat. cell=3.7-4.6 μ ; long. cell=3.7-7.5 μ ; lat. heterocyst=4.6-7.5μ ; long. heterocyst=6.6-7.5 μ ; lat. spore=6.6-11.2 μ ; long. spore= 10.5-22.5 μ.

Habitat : In a pond on Phagwara Road, Hoshiarpur.

13. **Anabaena oscillarioides** Bory in Born. et Flah. 233, 1888 ; Geitler 886, fig. 567 e, 1932.

var. **crassa** var. nov. (Figs. 5-7).

Plant mass soft, mucilaginous, blue-green ; trichomes straight, or curved, constricted at septa, blue-green ; end cell with rounded apices ; cells barrel-shaped, as long as broad or slightly shorter or longer than broad, contents granular ; heterocysts spherical, rarely slightly barrel-shaped, intercalary ; akinete on both sides of the heterocyst, single or in series, cylindrical.

Planta mollis, mucilaginosa, caeruleo-viridis ; trichomata recta vel curvata, constricta ad septa, caeruleo-viridia ; cellulae terminales apicibus rotundatis ornatae ; cellulae doliiformes, aeque longae ac latae, vel paulo breviores vel longiores, contentis granularibus ; heterocysta sphaerica, raro paulo doliiformia, intercalaria ; akinetes efformati ad utrumgue latus heterocysti, singuli vel seriati, cylindrici. Typus positus in P.U. College, Hoshiarpur, sub numero *Vasishta* 1.

Lat. trichome=5.6-7.5 μ (usually 6.6 μ); long. cell=3.7-8 μ; lat. heterocyst=7.5-11.2 μ; long. heterocyst=7.5-11.2 μ; lat. spore=7.5-11.2 μ; long. spore=15-33.7 μ (rarely 37.4 μ).

Habitat: In the stagnant water of a roadside pond, Phagwara Road, Hoshiarpur, 15-1-1960.

This variety resembles the type in possessing (a) trichomes with rounded end cells, (b) shape of cells and heterocysts, (c) shape of spores, and (d) spores are up to three or three and half times as long as broad; but differs in possessing (a) broader cells, (b) broader heterocysts, and (c) broader spores.

This variety differs from var. *angustus* Bharadwaja in possessing (a) broader trichomes and broader heterocysts, (b) heterocysts spherical and not ellipsoidal, and (c) broader spores that are smaller in length and are not surrounded by any special mucilaginous sheath.

The type of the variety is deposited in the herbarium of Panjab University College, Herbarium, *Vasishta* 1.

14. **Anabaena mehrai** sp. nov. (Figs. 8-12).

Trichome single, curved or straight, mucilaginous sheath absent, constricted at the joints; end cell with rounded apices; cells spherical or slightly barrel-shaped, as long as broad, or slightly shorter than broad, contents blue-green, pseudovacuoles present; heterocysts intercalary, spherical; akinetes usually spherical, rarely oval, always contiguous to the heterocysts, outer wall yellow-brown in colour.

Trichomata singularia, curvata vel recta, vagina mucilaginosa nulla, constricta ad septa; cellulae terminales apicibus rotundatis ornatae; cellulae sphaericae vel tenuiter doliiformes, aeque longae ac latae vel paulo breviores, contentis caeruleo-viridibus, pseudovacuola adsunt; heterocysta intercalaria, sphaerica; akinetes vulgo sphaerici raro ovati, semper contigui heterocystis, parietibus exterioribus luteo-brunneis. Typus positus in P.U. College, Hoshiarpur, sub numero *Vasishta* 4329.

Lat. cell=6.5-8 μ; long. cell=5.6-7.5 μ; lat. cell at the apex=5.1 μ; diameter heterocyst=7.5-11.2 μ; diameter spore=9.3-15 μ.

Habitat: Planktonic in a roadside pond, Phagwara Road, Hoshiarpur, 29-9-1958.

The present species resembles *Anabaena spiroides* Klebhan and *A. werneri* Brünn in possessing pseudovacuoles in the cells, but differs from the former in not possessing spirally coiled trichomes, in the absence of a broad mucilage sheath around the trichomes, in broader heterocysts and in the spores being always contiguous to the heterocyst. It differs from *A. werneri* in that the akinetes are not variable in position but are always present next to the heterocyst. The present species also differs from *A. planktonica* Brünn in not possessing a broad mucilage sheath around the trichomes and in the greater diameter of the cells and heterocysts. This form approaches *A. sphaerica*, *A. fertilissima*, *A. gelatinicola*, *A. anomala*, and *A. randhawae* in possessing spherical heterocysts but differs from all these species in possessing pseudovacuoles in the cells and from individual species in several respects.

The present form may, therefore, be regarded as a new species of *Anabaena* and the author takes great pleasure in naming it after Dr. P. N. Mehra, D.SC., F.N.I., Professor of Botany, Panjab University, and one of the distinguished botanists of India.

The type specimen is deposited (in the form of camera lucida drawings) in the herbarium of Panjab University College, Hoshiarpur, *Vasishta* 4329.

Subfamily AULOSIRAE Born. et Flah.

AULOSIRA Kirchner

15. **Aulosira prolifica** Bharadwaja in Ann. Bot. Lond. 47 : 131, figs. 5, 6, 1933 a.

Lat. filam.=5-7.5 μ; crass. vag. outer=1.87 μ, crass. vag. inner=1 μ; lat. cell=3.4-4.5 μ; long. cell=6-15 μ (rarely 22.2 μ); lat. heterocyst =4.5-8 μ; long. heterocyst=7.5-12 (-18) μ.

Habitat : Forming a blue-green to pale-brownish scum floating on the surface of stagnant water of a semi-permanent pond, Phagwara Road, Hoshiarpur.

The filaments in the Hoshiarpur alga are broader than the type.

NODULARIA Mertens

16. **Nodularia spumigena** Mertens ex Bornet et Flahault in Rev. Nostoc. Héteroc. 245, 1888 ; Geitler 866, fig. 554 b, c, 1932.

Lat. filament=8.5-11.9 μ; lat. trichome=8-10.2 μ; long. cell=3.7 μ; lat. heterocyst=9.5-12.5 μ; long. heterocyst=5.8-8 μ; lat. spore=11-11.25 μ; long. spore=7.5-8.5 μ.

Habitat : In a semi-permanent pond on Phagwara Road, Hoshiarpur. It occurs mixed with other algae.

In specimens collected from Hoshiarpur, occasional occurrence of terminal heterocysts has been noticed. The filaments are usually curved and even coiled in an irregular manner. It has also been observed that two daughter cells of a recently divided cell become converted into two terminal heterocysts which break apart resulting in the formation of two filaments each with a terminal heterocyst.

Family OSCILLATORIACEAE Kirchner

OSCILLATORIA Vaucher

17. **Oscillatoria subbrevis** Schmidle in Bot. Jahrb. 30 : 243, pl. 4, fig. 7, 1901 ; Geitler 949, fig. 601 b, 1932.

Lat. trichome=6.8-8.5 μ ; long. cell=1.7-2.5 μ.

Habitat : On moist soil, Hoshiarpur.

18. **Oscillatoria chlorina** Kütz. ex Gomont, Mon. Oscill. 233, 1892 ; Geitler 951, fig. 611 c, 1932. *Oscillatoria tenuis* Ag. var. *chlorina* (Kütz.) Playf. Biol. Richmond River 132, pl. 6, fig. 10, 1914.

Lat. trichome=3.4-4.2 μ ; long. cell=3.4-8.5 μ.

Habitat : On moist soil ; in stagnant water of a temporary pond, Hoshiarpur.

19. **Oscillatoria claricentrosa** Gardner in Mem. N.Y. Bot. Gard. 7 : 37, pl. 8, fig. 72, 1927 ; Geitler 971, fig. 615 c, 1932.

forma **bigranulata** Rao in Proc. Indian Acad. Sci. B 6 : 367, fig. 7 c, 1937 b.

Lat. trichome=2-3 μ ; long. cell=4-10 μ.

Habitat : Sides of a water tank, Panjab University College, Hoshiarpur.

LYNGBYA Ag.

20. **Lyngbya spiralis** Geitler, Kryptog. 1042, fig. 659, 1932.

Lat. filament=5.1-6.8 μ; lat. trichome=4.5-5.1 μ ; long. cell=1.7-2.5 μ ; crass. vag.=0.3-0.8 μ.

Habitat : Along with other algae in a permanent pond near railway crossing at village Nasrala, Hoshiarpur.

21. **Lyngbya martensiana** Menegh. ex Gomont, Mon. Oscill. 145, fig. 17, pl. 3, 1892 ; Geitler 1064, fig. 676, 1932.

Lat. filament=13.4-15.3 μ ; lat. trichome=10.2-11.5 μ long. cell=2.5-3.4 μ ; crass. vag.=1.7 μ.

Habitat : In a roadside pond, Phagwara Road, Hoshiarpur.

22. **Lyngbya allorgei** Frémy 189, fig. 156, 1929 ; Geitler 1059, fig. 671, 1932.

Lat. filament=5.1-5.9 μ ; crass. vag.=0.85 μ ; lat. trichome=3.4-4.2 μ ; long. cell=5.1-5.9 μ.

Habitat : On moist soil in flower pots, mixed with *Hormidium flaccidum*, Panjab University College, Hoshiarpur.

23. **Lyngbya gardneri** Geitler 1037, 1932. *L. erecta* Setchell et Gardner in Proc. Acad. Sci., 4th ser., 122, 1930, (non *L. erecta* Setchell et Gardner, 1927).

Lat. filament=1.7-2.5 μ; lat. trichome=1.3-1.7 μ; long. cell=3.4-6.8 μ; long. filament=1-2 mm.

Habitat: On soil at the bottom of a pond at Hoshiarpur.

It forms yellowish green masses attached to the soil at the bottom of ponds. The basal cell becomes slightly flattened at its lower end and serves as an attaching organ.

24. **Lyngbya perelegans** Lemm. in Abh. nat. ver. Bremen 16 : 355, 1899, et 18 : 153, pl. 11, figs. 13-14, 1904 ; Kryptog. Mark Brand. 3 : 138, 1910 ; Geitler 1056, fig. 66 a-c, 1932.

Lat. filament=1.7-2.5 μ; lat. trichome=1.5-2 μ; long. cell=2.5-3.4 μ. A single granule is present on either side of the septa.

Habitat: On the bottom mud of a pond at Hoshiarpur.

25. **Lyngbya palmarum** (Mertens) Brühl et Biswas in Jour. Dept. Sci. Calcutta Univ. 11, pl. 4, fig. 14, 1923. *Scytonema palmarum* Martens in Proc. Asiatic Soc. Bengal 39 : 11, 1870.

Lat. filament=7.6-8.5 μ; lat. trichome=6.8 μ; long. cell=5.1-8.5 μ, crass. vag.=0.85-1 μ.

Habitat: On the bark of a palm tree in Panjab University College, Hoshiarpur.

It forms dark-coloured extensive and densely tomentose thallus on the trunks of palm trees. During dry months the thallus becomes pale green to pale yellow.

SYNOPSIS

A detailed account of the ecology and systematics of some of the blue-green algae of district Hoshiarpur has been given in this paper. This district affords unique opportunities of algal collections from aquatic, sub-aerial, and aerial habitats, and has been correctly noted by Dr. M. S. Randhawa as an ' algologist's paradise '.

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The Genus *Veronica* Linn. of Eastern India

BY

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(*With a plate*)

The genus *Veronica* of the family Scrophulariaceae has altogether 250 species, which are mostly distributed in the temperate countries of the world and are sometimes alpine. Of these, 35 species are found in India, out of which only 18 species were described by Hooker in his FLORA OF BRITISH INDIA **4** (1885), and the remaining 17 species were later reported by Pennell.

Only 9 species are found in this part of India, and are mostly distributed on the hills of Assam, Sikkim, and Bhutan. In the present paper, these 9 species, viz. *V. capitata* Royle ex Benth., *V. lanuginosa* Benth. ex Hook., *V. ciliata* Fisch., *V. javanica* Blume, *V. cana* Wall., *V. anagallis* Linn., *V. deltigera* Wall., *V. himalensis* D. Don, and *V. hederaefolia* Linn. are described and a specific key is given for their easy identification. The species *V. hederaefolia* Linn., which was previously reported from Kashmir, has been discovered in Sikkim.

Another variety, *V. anagallis* Linn. var. *montioides* Boiss., is also described here. This variety, reported formerly from W. Tibet and Afghanistan, has been found further east in the Sangpo-Valley on the Assam-Tibet frontier.

This work is part of a study on Scrophulariaceae of eastern India which the author is carrying on at present. In connection with the present study he received a grant for field work from the Bombay Natural History Society, from funds made available by the Rockefeller Foundation. He takes this opportunity to express his sincere thanks to the authorities for this generous help.

Veronica Linn. Sp. Pl. 9, 1753.

Perennial or annual herbs, shrubs or rarely trees. *Leaves* simple, opposite, rarely upper alternate, exstipulate. *Inflorescence* racemose or solitary. *Flowers* pedicellate or sessile, bisexual, complete, irregular, hypogynous, usually bracteate, white, blue or purple. *Calyx* 4-5-partite, united at the base, imbricate. *Corolla* 4-5-partite, gamopetalous, rotate or salver-shaped ; lobes unequal, obtuse, entire ; lateral broader, outer in bud ; imbricate. *Stamens* 2, epipetalous, attached to the upper lobe, exserted, anther-cells parallel or divergent. *Ovary* : carpels 2, syncarpous, 2-celled, superior ; style filiform ; stigma subcapitate or bilobed ; ovules many in each cell ; placentation axile. *Fruit* a capsule, compressed or turgid, 2-grooved. *Seeds* many or few, various in shape, sometimes winged.

KEY TO SPECIES

A. Flowers in racemes
B. Flowers sessile or subsessile
C. Capsule broadly obcordate, laterally flattened .. .. .. *capitata*
CC. Capsule ovoid or oblong, slightly laterally compressed
D. Leaves orbicular or broadly ovate, woolly, very close and covering the stem .. .. .. *lanuginosa*
DD. Leaves ovate or oblong, pubescent, not close and covering the stem .. .. .. *ciliata*
BB. Flowers pedicellate
C. Leaves petiolate
D. Annual. Capsule broadly obcordate .. *javanica*
DD. Perennial. Capsule truncated .. *cana*
CC. Leaves usually sessile
D. Stem succulent .. .. *anagallis*
DD. Stem not succulent
E. Leaves usually 1-4 cm. long. Inflorescence short-peduncled .. *deltigera*
EE. Leaves usually 4-9 cm. long. Inflorescence long-peduncled *himalensis*
AA. Flowers solitary .. .. .. *hederaefolia*

1. **Veronica capitata** Royle ex Benth. Scroph. Ind. 45, 1835.

Herb. *Stem* short, suberect, pubescent. *Leaves* sessile or shortly petiolate, opposite, largest pair often uppermost, ovate or shortly oblong, obtuse or acute, crenate-serrate or subentire, usually pubescent, rarely glabrous, base rounded, 1-4 cm. long, 0.8-2 cm. wide. *Inflorescence* terminal, villous, in umbels or heads. *Flowers* sessile or subsessile, white or blue, small. *Calyx* : sepals 4-5, gamosepalous, spathulate-oblong, obtuse, 0.3 cm. long. *Corolla* : petals 4-5, gamopetalous, white-blue, 0.5 cm. long. *Stamens* 2 ; filaments filiform. *Ovary* ciliate ; style simple, stigma bilobed. *Fruit* a capsule, ciliate, broadly obcordate, 0.4 cm. in diameter. *Seeds* elliptic, flattened.

Koteh-ya-my (4650 m.), Aug. 1888, *Dr. King's collector* ; Pey-King-la, July 1887, *Dr. King's collector* ; Tumbok (3700 m.), 10th Oct. 1870, No. 12915D ; Teesta Valley above Tangu (4080 m.), 6th July 1903, *F. E. Younghusband* ; Kambajong, Sept. 1903, *D. Prain* ; Yakla (4330 m.), 18th Oct. *C. B. Clarke* 10142 ; Mt. Singhulalah (3700 m.), 3rd June 1892, *G. A. Gammie* 61 ; Teumtong (3400 m.), May 1885, *Dr. King's collector*.

2. **Veronica lanuginosa** Benth. ex Hook. f. Fl. Brit. Ind. 4 : 293, 1885.

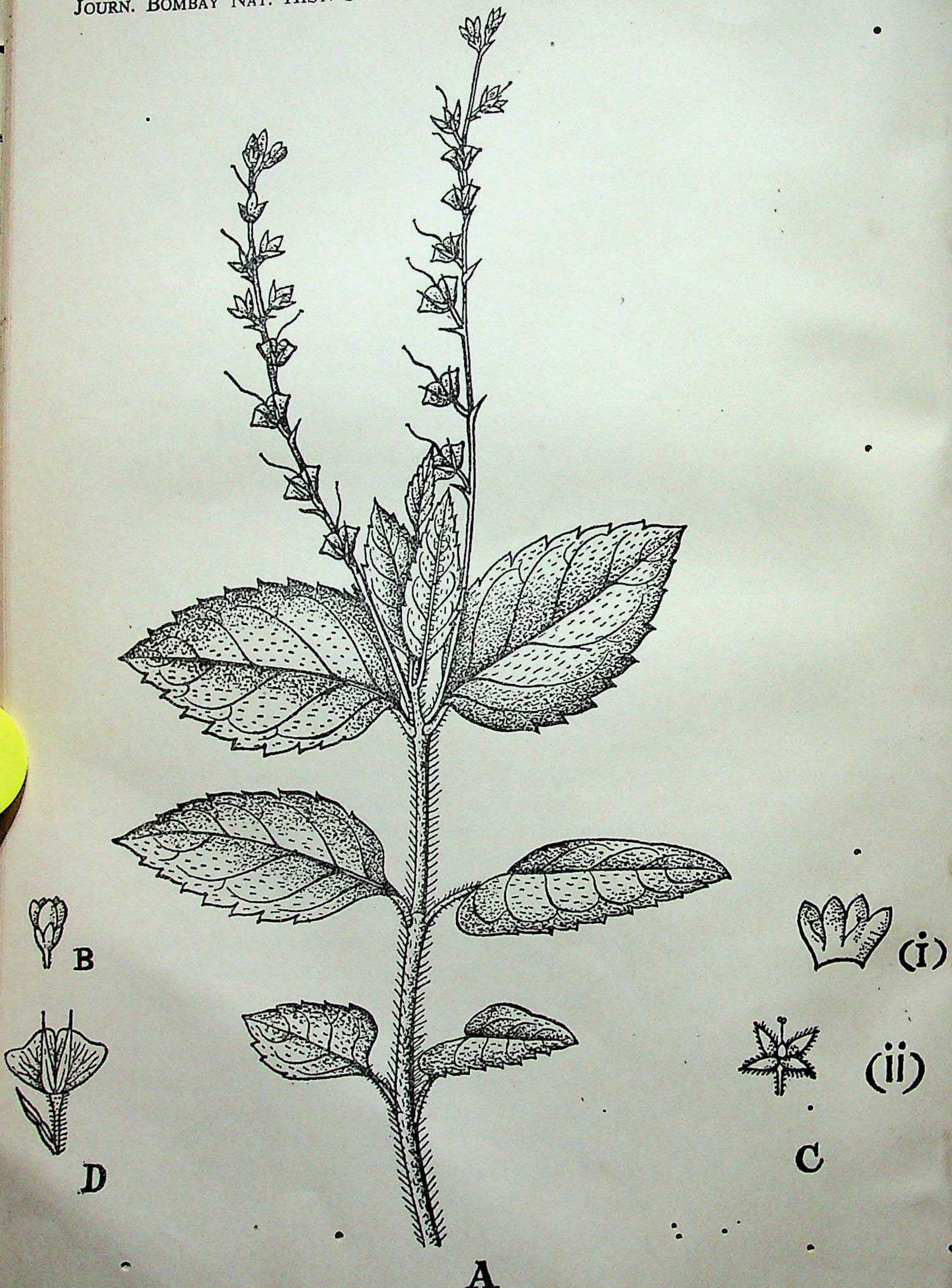
Herb. *Stem* densely woolly, 5-7 cm. long. *Leaves* sessile, opposite, orbicular or upper broadly ovate, obtuse or subacute, entire, woolly, very close and covering the stem, 0.4-1.2 cm. long, 0.4-1.2 cm. wide. *Inflorescence* terminal, in woolly heads. *Flowers* sessile, small, bracteate, deep blue in colour. *Calyx* : sepals 4, gamosepalous, oblong, subacute, 0.3 cm. long, persistent. *Corolla* : petals 4, gamopetalous, spathulate, upper orbicular, larger and broader than the others, ± 0.6 cm. long. *Stamens* 2 ; filaments short. *Ovary* elliptic ; style ± 0.4 cm. long ; stigma bilobed. *Fruit* a capsule, elliptic notched, pubescent, equalling the sepals. *Seeds* plano-convex, oblong.

Rangsa, Llovok (4800 m.) 28th July 1909, *Smith & Cave* 2023 ; Nakula, 28th July 1903, *F. E. Younghusband* 223 ; Thang Chung la (4900 m.), 15th July 1909, *Smith & Cave* 1476.

3. **Veronica ciliata** Fisch. in Mem. Soc. Nat. Mosc. 3 : 56, 1812. *V. alpina* George, Reise 1 : 195, 1775. *V. macrocarpa* Turez. ex Steud. Nom. (ed. 2) 2 : 758, 1841. *Bartsia mollis* Turez. ex Herd. in Bull. Soc. Nat. Mosc. 58 : 1. 397, 1883.

Erect herb. *Stem* stiff, hoary-pubescent, 10-30 cm. long. *Leaves* sessile, opposite, ovate or oblong, obtuse or acute entire, serrate or crenulate, pubescent, 0.8-4 cm. long, 0.5-1.5 cm. wide. *Inflorescence* of terminal hirsute heads. *Flowers* sessile, bracteate ; bracts equalling the calyx. *Calyx* : sepals 4, gamosepalous, oblong, obtuse, pubescent, ± 0.5 cm. long. *Corolla* : petals 4-5, gamopetalous, small, broad, reddish blue, ± 0.6 cm. long. *Stamens* 2, included ; anther cells 2, parallel, obtuse. *Ovary* ovoid ; style filiform ; stigma bilobed. *Fruit* a capsule, ovoid-oblong, notched. *Seeds* orbicular, plano-convex, compressed.

Thangu (4270 m.), Sept. 1909, *Lepcha collector* 2914 ; Sikkim (3400-4270 m.), *J. D. Hooker* ; Llovok (4420 m.), 1st Aug. 1909, *Smith & Cave* 1841 ; Nakuchu (4950 m.), 4th Aug. 1909, *Smith & Cave* 1994 ; Lungma chu (4950 m.), 6th Aug. 1909, *Smith & Cave* 2239 ; Naku La, 29th July 1903, *F. E. Younghusband* 232 ; Momay Samdong, Lachung (4950 m.), 17th Aug. 1892, *G. A. Gammie* 851 ; Kung-met, 3rd Aug. 1884, *Dungboo* 301.



A. *Veronica cana* Wall. var. *rubbata* × 1; B. Flower × 1½; C. Flower dissected open: (i) Corolla with epipetalous stamens × 2; (ii) Pistil with calyx × 2; D. Fruit with bract × 2½.

4. **Veronica javanica** Blume, Bijd. 742, 1826. *V. maddeni* Edgew. ex Hook. f. Fl. Brit. Ind. 4 : 296, 1885.

Annual herb. *Stem* much branched, spreading from the root, ascending, 15-45 cm. long, pubescent. *Leaves* petiolate, petiole 0.3-0.8 cm. long, rarely sessile, ovate, sub-cordate or truncate, obtuse, crenate-serrate, base rounded, pubescent. *Inflorescence* in axillary racemes. *Flowers* pedicellate (pedicels ± 3 mm. long), blue or white, 5 mm. in diameter, bracteate ; bracts longer than pedicels. *Calyx* : sepals 4, linear-oblong, obtuse, ± 3 mm. long. *Corolla* : petals 4, ± 5 mm. long. *Stamens* 2 ; anthers basifixed. *Ovary* pubescent. *Fruit* a capsule, cordate, narrowed to the base, 3 mm. in diameter. *Seeds* elliptic, biconvex.

Great Nanget Valley, *S. Kurz* ; Banquet Valley (1525 m.), May 1862, *T. Anderson* 272A ; Phedong (900 m.), 13th May 1876, *C. B. Clarke* 27918B ; Shillong (1525 m.), 16th May 1885, *C. B. Clarke* 38184E ; Dibrooghur (900 m.), 5th April 1885, *C. B. Clarke* 37741A ; Talap-Lakhmipur, 23rd March 1894, *G. A. Gammie* 188 ; Kabo, 10th March 1912, *I. H. Burkill* 36796 ; Dumpep-Khasia hills (1925 m.), 30th May 1911, *I. H. Burkill & S. C. Banerjee* 34250.

5. **Veronica cana** Wall. [Cat. 401 1828] ex Benth. Scroph. Ind. 45, 1835; DC. Prodr. 10 : 475, 1846 ; Fl. Brit. Ind. 4 : 295, 1885.

Perennial herb. *Stem* 15-30 cm. long, ascending, usually slender, pubescent, villous or glabrous. *Leaves* petiolate (petioles 0.2-1.5 cm. long) opposite, ovate or ovate-cordate, obtuse or sub-acute, crenate or serrate, pubescent or glabrous, 1-4 cm. long, 0.7-2.4 cm. wide. *Inflorescence* a raceme, axillary or terminal. *Flowers* pedicellate (pedicels equalling or shorter than the calyx), bracteate ; bracts small, linear, shorter than the calyx. *Calyx* : sepals 4, united just at the base, unequal, linear-oblong, obtuse, ± 3 mm. long. *Corolla* : petals 4, gamopetalous, lateral outer in bud, upper and lower usually narrowest, ± 5 mm. long, imbricate, white or blue. *Stamens* exserted ; filaments filiform, ± 3 mm. long ; anthers cordate, obtuse, less than 0.5 mm. long, basifixed. *Ovary* oval ; style filiform, ± 2-8 mm. long, persistent. *Fruit* a capsule, truncate, glabrous or ciliate, ± 6 mm. in diameter. *Seeds* flat, ovate-oblong, thin.

Lachumy, July 1879, *King's collector* ; Bhutan (1500 m.), 1st June 1906, *J. C. White* ; Zemu valley (3340 m.), 10th July 1909, *Smith & Cave* 416 ; Lamtang to Tangu (3070 m.), 1st July 1909, *F. E. Younghusband* T 23 ; Buckeem (2400 m.), 12th Oct. 1875, *C. B. Clarke* 2529, 25293A ; Tongir (4000 m.), 15th Oct. 1875, *C. B. Clarke* 25835 C ; Tankra Mt. (3070 m.), 5th August 1892, *G. A. Gammie* 622 ; Latong swamps (2150 m.), May 1885, *King's collector* ; Sikkim, *R. Seshagiri Rao* 595.

(*a*) **Veronica cana** Wall. var. **robusta** Prain in Journ. As. Soc. Bengal 20 : 20, 1903. (see Plate)

This variety differs from *V. cana* proper in the following points : (i) robust habit, (ii) denser tomentum, (iii) larger leaves, (iv) sepals lanceolate and acute, and (v) anthers hastate and larger.

Perennial herb. *Stem* erect, robust, up to 50 cm. long, tomentose or hispid. *Leaves* petiolate (petioles 1-2 cm. long), opposite, ovate or ovate-oblong, sub-acute, serrate, tomentose, 3-5.5 cm. long, 1.5-3.3 cm. wide. *Inflorescence* a raceme, axillary or terminal. *Flowers* pedicellate, bracteate, bracts equalling the calyx. *Calyx* : sepals 4, united at the base, lanceolate, acute, hairy, 4 mm. long. *Corolla* : petals 4, gamopetalous, imbricate, 5 mm. long. *Stamens* epipetalous ; filaments filiform, ± 3 mm. long ; anthers hastate, basifixed, ± 1 mm. long. *Ovary* 2-celled ; style terminal, ± 2-10 mm. long, persistent ; stigma bilobed. *Fruit* a capsule, truncate. *Seeds* ± 1 mm. long, flat, ovate-oblong, thin with two dark swelling points, one at the centre and another at the base.

Tangloo (300 m.), Aug. 1887, *King's collector*, Lectotype in Herb. Cal. ; Sikkim, 15th Oct. 1868, *S. Kurz* ; Kallipola, June 1887, *King's collector* ; Kallipokri, June 1887, *King's collector* ; North of Tonglu (2800 m.), 19th May 1909, *I. H. Burkill* 32007.

6. **Veronica anagallis** Linn. Sp. Pl. 12, 1753 ; Benth. in DC. Prodr. 10 : 467, 1846 ; Reichle, Ic. Fl. Germ. t. 1762, 1862 ; Boiss. Fl. Orient. 4: 473, 1879 ; Fl. Brit. Ind. 4 : 293, 1885 ; Beng. Pl. 2 : 773, 1903. *V. acutifolia* Gilib. Exercit. 1 : 119, 1792. *V. aquatica* S. F. Gray, Wat. Arr. Brit. Pl. 2 : 306, 1821. *V. ambigua* Luce, Topog. Nachr. Oesel 4, 1823. *V. undulata* Wall. Cat. 406, 1828. *Cordia amplexicaulis* Dulac, Fl. Haute Pyr. 387, 1867: *Beccabunga anagallis* Fourr. in Ann. Soc. Linn. Lyon. (N.S.) 17 : 128, 1869.

According to Pennell this species should be written as *V. anagallis-aquatica* Linn.

Perennial succulent herb, erect or decumbent. *Stems* usually glabrous, rarely pubescent, hollow, 15-50 cm. long. *Leaves* sessile, rarely shortly petioled, lanceolate, oblong-ovate or ovate-lanceolate, acute or obtuse, entire or serrate, base usually auriculate rarely cordate, glabrous, 2-11 cm. long. 0.3-3 cm. wide. *Inflorescence* axillary, many-flowered raceme. *Flowers* pedicellate, bracteate (bracts conspicuous), white or pink, small, 4-6 mm. in diam. *Calyx* : sepals 4, polysepalous, ovate, sub-acute, 2-4 mm. long. *Corolla* : petals 4 , gamopetalous, rotate, lateral outermost, broadly elliptic 0.25-0.3 cm. long, upper lobe broadly ovate, 0.25 cm. long, white or pink. *Stamens* exserted ; anthers obtuse. *Ovary* round. *Fruit* a capsule, compressed, orbicular or orbicular-oblong, notched, glabrous, 0.2-0.25 cm. long. *Seeds* ovoid or oblong, biconvex, rugulose.

Kung-met, 3rd Aug. 1884, *Dungboo* 300 ; Dong-dong, 10th July 1906, *J. C. White* ; Kamikha, March 1893, *King's collector* ; Goalpara

(90 m.), 5th March 1886, *C. B. Clarke* 43175A ; Maldah, 29th April 1874, *C. B. Clarke* 26264 ; Lakhimpur (Libru river banks), 29th March 1915, *H. G. Carter* 41139.

(*a*) **Veronica anagallis** Linn. var. **montioides** Boiss. Fl. Orient. 4 : 437, 1879 ; Fl. Brit. Ind. 4 : 293, 1885. *V. pusilla* Benth. in DC. Prodr. 10 : 468, 1846.

Dwarf, slender herb. *Stems* often simple. *Leaves* sessile, opposite, acute; sub-acute or obtuse, entire or serrate, 0.2-1 cm. long, 1-5 mm. wide. *Inflorescence* in racemes, few-flowered.

Sangopo Valley (Brahmapootra), July 1904, *H. J. Walton.*

7. **Veronica deltigera** Wall. [Cat. 402, 1828] ex Benth. Scroph. Ind. 45, 1835 ; Benth. in DC. Prodr. 10 : 475, 1846 ; Fl. Brit. Ind. 4 : 292, 1885. *V. lanosa* Benth. Scroph. Ind. 45, 1835. *V. rupestris* Aitch. & Remsel in Journ. Linn. Soc. 19 : 180, t. 25, 1882.

Perennial herb. *Stems* many from the root, rigid, slender, sub-simple, ascending, pubescent, with prominent nodes. *Leaves* sessile, opposite, ovate, ovate-oblong or oblong-lanceolate, serrate, base-rounded or acute, glabrous, 1-4 cm. long, 3-15 mm. wide. *Inflorescence* terminal or axillary in short peduncled, pubescent racemes. *Flowers* pedicellate, blue, bracteate ; bracts often leaf-like, upper oblong, 1-2 cm. in diam. *Calyx* : sepals 4, gamosepalous, linear-oblong, sub-acute, 0.2-0.4 cm. long. *Corolla* 4- or 5-lobed, lobes broad, ± 6 mm. long. *Stamens* : filaments short ; anthers basifixed. *Ovary* : style filiform, 3-6 mm. long ; stigma sub-capitate. *Fruit* a capsule, oblong-ovoid, obtuse, ± 4 mm. long, equalling or shorter than the calyx. *Seeds* minute, irregularly suborbicular, plano-convex, much flattened.

Gopian-Than, Aug. 1821, in Herb. Cal.

8. **Veronica himalensis** D. Don, Prodr. Fl. Nep. 92, 1825 ; Benth. in DC. Prodr. 10 : 467, 1846 ; Fl. Brit. Ind. 4 : 292, 1885. *V. grandiflora* Wall. Cat. 403, 1828.

Herbs. *Stem* stout, erect, glabrous, 30-60 cm. long. *Leaves* sessile, in distant pairs, lower opposite, upper rarely alternate, ovate-lanceolate, all coarsely irregularly serrate, acute, 4-9 cm. long, 1-3 cm. wide, base rounded or auriculate ; nerves beneath pubescent. *Inflorescence* in erect racemes, axillary, towards the apex of the branches ; peduncles long. *Flowers* pedicellate (pedicels about equalling the calyx), bracteate (bracts 5-8 mm. long, linear-oblong), blue. *Calyx* : sepals 4-5, united at the base, oblong, acute, hairy, 6 mm. long. *Corolla* : petals 4, oblong, large, 8 mm. long. *Stamens* alternate with petals ; anthers sagittate. *Ovary* : style filiform, 6-9 mm. long ; stigma subcapitate. *Fruit* a capsule, ovoid, acute, ± 7 mm. long. *Seeds* minute, irregularly suborbicular, plano-convex, flattened.

Chakung chu (3400-3700 m.), 30th July 1910, *W. W. Smith* 3969 ; Ninghil (4000 m.), 7th Aug. 1910, *W. W. Smith* 4123 ; Zemu valley (3700 m.), 11th July 1909, *Smith & Cave* 1214 ; Gararang pasture, Sept. 1901, *Prain's collector* 189 ; Bogtop, Oct. 1908, *Ribu* ; Damkerka (3700 m.), Aug. 1888, *King's collector* ; Dothes, July 1879, *Dungboo.*

9. **Veronica hederaefolia** Linn. Sp. Pl. 13, 1753 ; Benth. in DC. Prodr. 10 : 490, 1846 ; Boiss. Fl. Orient. 4 : 468, 1879 ; Fl. Brit. Ind. 4 : 294, 1885. *V. cymbalarifolia* J. F. Gmel. Enum. Tubing. 6, 1772. *V. lappago* Schrank, Baier Fl. I : 218, 1789 ; *V. umbrosa* Reichb. ex Schult. Mant 1: Add. 11. 229 in syn. 1822 ; *Cochlidiospermum hederaefolium* Opiz. Seznam 31, 1852. *C. lappago* Opiz. in Lotoz. 4 : 158, 1854. *Pocilla hederaefolia* Fourr. in Ann. Soc. Linn. Lyon, N.S. 17 : 129, 1869.

Herb. *Stems* prostrate, hairy or glabrous ; branches numerous. *Leaves* petiolate (petioles 0.3-1 cm. long), orbicular-ovate, 5-7-lobed (lobes rounded), alternate or opposite pubescent or glabrous, 0.5-2 cm. long, 0.8-2.5 cm. wide. *Inflorescence* solitary. *Flowers* pedicellate (pedicels 1-2.5 cm. long), axillary, bracteate. *Calyx* : sepals 4 or 5, membranous, cordate, acuminate, ciliate, exceeding the corolla, persistent. *Corolla* : petals 4 or 5, pale blue, ± 6 mm. diam. *Stamens* : anthers oblong. *Ovary* : style filiform ; stigma subcapitate. *Fruit* a capsule, globose ; cells 1- or 2-seeded. *Seeds* large, rugose, subglobose, with a deep pit on the inner face, black.

Sikkim, *R. Seshagiri Rao* 326.

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Report on the status of the Browantlered Deer of Manipur (India):

October-November 1959 and March 1960

BY

E. P. GEE, M.A., C.M.Z.S.

(With 3 plates and 3 maps)

(Communicated by the Survival Service Commission of the International Union for the Conservation of Nature and Natural Resources)

CONTENTS

PAGE

I. INTRODUCTION 597
II. GENERAL REVIEW AND SUMMARY OF REPORT 599
III. HISTORY OF THE BROWANTLERED DEER AREA IN MANIPUR .. 601
IV. GEOGRAPHY AND ECOLOGY 602
V. ADMINISTRATIVE AND POLITICAL 606
VI. GENERAL ACCOUNT OF THE SURVEY 608
VII. STATUS, DISTRIBUTION, AND FUTURE OF THE BROWANTLERED DEER IN MANIPUR 612
VIII. RECOMMENDATIONS 615
IX. ACKNOWLEDGEMENTS 616
X. GLOSSARY OF LOCAL TERMS 616
REFERENCES 617

I. INTRODUCTION

This report deals with *Cervus eldi eldi* McClelland, 1842, the Manipur (India) subspecies of a very beautiful deer which is only found in the south-western portion of the Logtak Lake in Manipur—a State of the Indian Union. In recent years it has become very rare, and for its preservation it became evident that more information about its numbers, habits, habitat, and so on was needed. This survey, sponsored by the International Union for the Conservation of Nature and approved of by the Indian Board for Wild Life, attempts to supply the required information, and makes recommendations for ensuring the continued survival of this subspecies.

The three sub-species of this deer may be briefly enumerated as follows:

(i) The Manipur subspecies, *Cervus eldi eldi* McClelland, 1842: Now found only in one small 10-square-mile (26 sq. km.) portion of the valley area of Manipur State in India. Locally known as *sangai* or *shangai*, and not as *sangnai* or *sangrai* as stated by Lydekker and certain subsequent writers. The stags commence shedding their antlers late in June, and new antlers are in velvet till November when they become full size. In December they become clear of velvet and hard, and remain so till early June. The rutting season is at its height in February and March, and the fawns are born in October and November. Fuller descriptions of its habitat and habits are given later in this report.

(ii) The Burma subspecies, *Cervus eldi thamin* (Thomas), 1918: Found in Upper and Lower Burma, and also possibly in parts of Thailand. Locally known as *thamin* or *thameng*. In 1955 U. Tun Yin made a compilation of reports received from Forest Officers, and concluded that there were then 3000—3500 *thamin* in the Union of Burma; and L. M. Talbot, who visited Burma in 1955, gave an estimate of 2500—3000. But subsequent reports from Burma indicate that the number may now be considerably less. For, although the *thamin* was declared by the Government of the Union of Burma in 1956 to be a 'completely protected species', it is feared that a great deal of illicit shooting is still going on.

(iii) The Thailand subspecies, *Cervus eldi siamensis* Lydekker, 1915: Found in Thailand and Viet Nam (and possibly in Cambodia, Laos, Viet Minh, and Hainan). Known in Thailand as *la-ong la-mang*, or *la-mang* for short (a big stag with good antlers is usually called *la-ong*, and a young stag or hind *la-mang*). In Cambodia it is known as *la-miang*. Formerly it abounded on the open plains and in the deciduous forests of Thailand, but now it is reliably reported by Dr. Boonsong Lekagul *in litteris* (May 1960) that it is on the verge of being lost. Only a few herds of four or five head are to be seen at Nang Rong in the north-east and at Chieng Karn in the north, and it is doubtful if these can be saved from extinction unless the Thai Government can take quick and effective steps to protect them.

The stags of the Browantlered Deer, or Eld's Deer, are described as standing about four feet (1.22 m.) high at the shoulder, and weighing from 210 lb. (95 kg.) to 245 lb. (111 kg.). The hinds are smaller. The maximum length of the antlers is 42 in. (107 cm.). The coat of the stags is rather coarse, and they develop a mane. There is a seasonal change in their coloration, from brown in the winter to chestnut in the summer. The young are spotted; and traces of spots can be seen in adults, even after several years.

This deer is readily distinguished from all other species of deer by the peculiar form of the antlers. These are set in the head at right angles to the pedicle, and the curve of the brow tines is continuous with that of the beams. The antlers of opposite sides are unsymmetrical when compared with one another. The beams are unbranched for some distance, much curved, and finally forked. In older stags the forward bend makes a distinct angle in the beam, while in young stags the curve is more continuous, like a prostrate letter C. The antlers of the Thailand subspecies are generally, if not always, palmated terminally.

The pasterns of the Manipur subspecies are hairless, hard, and horny, specially adapted for moving about on swampy ground and for preventing it from sinking through the surface mat of reeds and grasses. The pasterns of the Burma and Thailand subspecies, which live in dry undulating country, are hairy.

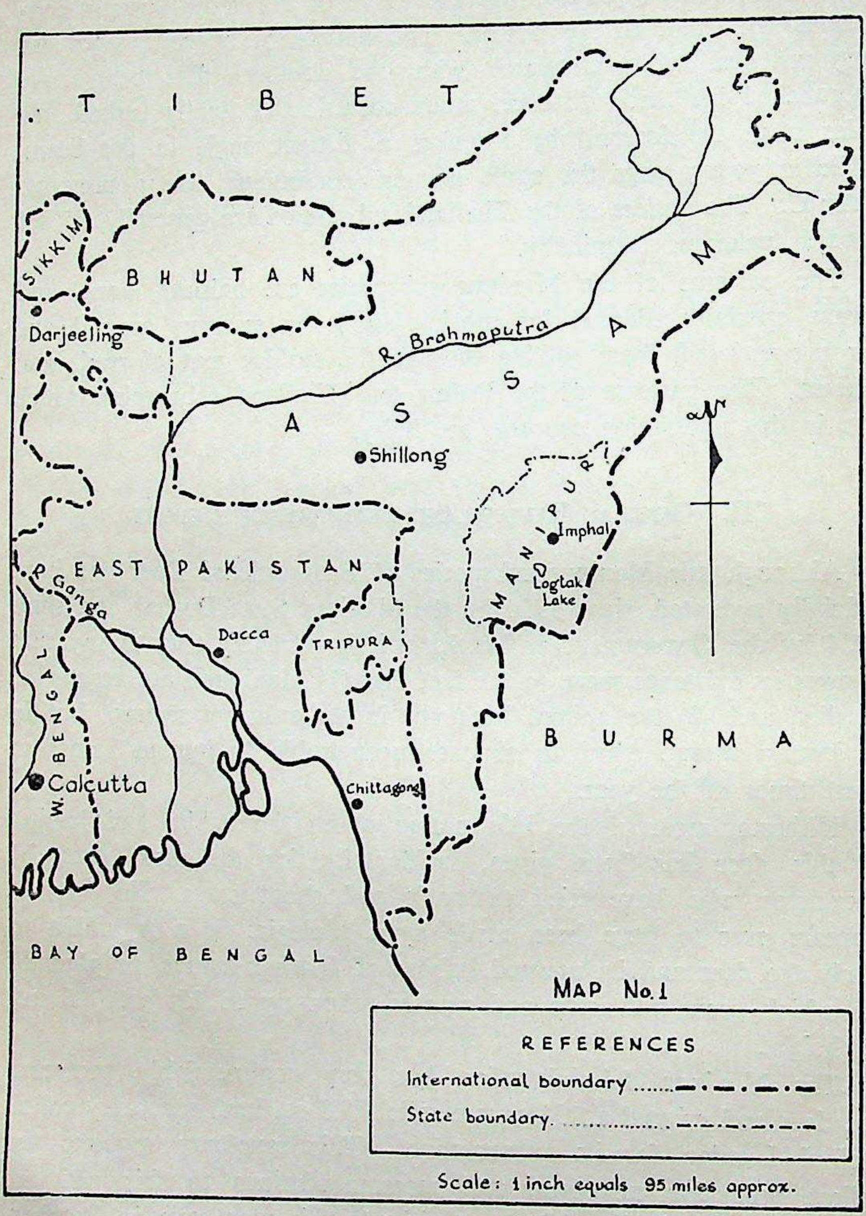
II. General Review and Summary of Report

Although this Manipur subspecies of Browantlered Deer has been officially protected, since 1934 by the Manipur State Durbar and since 1954 by the Government of Manipur, it is probably true to say that it owes its existence more to the fact that (1) Manipuris are vegetarian in diet, and (2) the animal lives not in an ordinary swamp, but in a *floating* swamp which is almost impenetrable to human beings at most times of the year.

Hitherto, most of the information about the habits and habitat of this deer has been given, incidentally for the most part, by sportsmen who have tried to track and shoot stags. No attempt appears ever to have been made by a biologist or a naturalist to study the deer and its unusual habitat of floating humus, or *phumdi*, on which grow tall reeds and grasses, often up to 15 feet (4.6 m.) in height.

The Manipur Administration has very commendably protected the deer and created a $10\frac{3}{4}$ square mile (27.8 sq. km.) sanctuary called Keibul Lamjao for its preservation. This sanctuary requires the fullest protective measures, and recommendations to this end are given in section VIII. After two visits to this sanctuary, in October-November 1959 and in March 1960, I estimate that approximately 100 of this Browantlered Deer now exist in Manipur.

It is considered that here is a good case for the preservation of rare and endangered animals by humanely capturing some of them and keeping them in a good zoological park or garden. It is extremely difficult, in fact almost impossible, to see or observe this deer in its natural habitat; and as it may have formerly existed in


TIBET
SIKKIM
BHUTAN
Darjeeling
R. Brahmaputra
ASSAM
Shillong
MANIPUR
Imphal
Logtak Lake
EAST PAKISTAN
R. Ganga
Dacca
TRIPURA
W. BENGAL
Calcutta
Chittagong
BURMA
BAY OF BENGAL
REFERENCES
International boundary
State boundary
Scale: 1 inch equals 95 miles approx.

MAP No. 1

undulating grassy areas near the foothills (as the Burma and Thailand subspecies now do), and as it is known to thrive and breed in captivity, it seems only reasonable that a few of them should be captured by the government department in charge of them, and kept under zoological park conditions.

As such they would not only be preserved and their numbers increased, but also they would be available for scientific observation, and be an attraction to the people of Manipur as well as to visitors from outside and tourists from abroad.

III. HISTORY OF THE BROWANTLERED DEER AREA IN MANIPUR

Before India became independent, Manipur was a princely state under its Maharaja, with a British Political Agent or Resident in charge of external and foreign affairs. The Maharaja had full charge of internal affairs, and was responsible for law and order. His 500 State troops were called in by him to assist the State police if a serious disturbance arose. If a disturbance could not be quelled by these, the last resort was the battalion of Assam Rifles under the control of the British Political Agent. A rebellion occurred in 1891. The nearest British garrison station was Kohima in the Naga Hills, and the road connecting Assam, Kohima, and Imphal in Manipur was opened in 1896.

During World War II nearly the whole of Manipur State, except the area round Imphal town and airfield, was occupied by Japanese troops from 1943-45. Later on the invading forces were driven back into Burma.

On India's achievement of independence in 1947 Manipur became a Class C State of the Indian Union with a legislative assembly. This was dissolved in 1948 and replaced by Chief Commissioner's rule under the Centre (New Delhi). Since the Reorganisation of States in 1957, Manipur has been a Territory of the Indian Union (like Tripura, Himachal Pradesh, and Delhi) with the Chief Commissioner in charge of the Manipur Administration, who is responsible to New Delhi. There is a Manipur Advisory Committee consisting of the Chief Commissioner, three members from Manipur of the Lok Sabha, and the chairman of the Territorial Council. The latter Council is elected from the people of Manipur and has control of education (except colleges) and of roads, except the national highway from Mao to Moreh, which is under the Manipur Administration. Since May 1960 there has been some political agitation in the State for the reconstitution of a legislative assembly in place of control from the Centre.

As for the *sangai*, prior to 1891 they were recorded (Alban Wilson, 1924) as having been 'preserved by order of the royal family, and any man who was proved to have killed one had his hand chopped off, but after we took over the affairs of the State the deer were allowed to take their chance, and the Mahommedans who lived in the vicinity were not long in waking up to the fact. They used to mount their buffalo, armed with spears, ride quietly up to the deer, surround them in the heavy grass, and then stick them . . . Luckily a sporting Political Agent finally issued orders to preserve this rare beast from indiscriminate slaughter . . .'

Protection given to the *sangai* is also referred to by H. S. Wood (1934): 'The various political officers of Manipur recognising the paucity, and probable extinction, of this animal, have framed very strict hunting rules, and the number of heads is limited . . .'

In 1934 by order of the Manipur State Durbar it was resolved that no further permits be issued for shooting these deer until further orders, as this animal was in danger of extinction.

In December 1951 the Government of Manipur informed the writer of this Report that 'enquiries have been made by the Forest Department and it has been found that this deer has become totally extinct and no alive specimen is now available . . . In view of what is stated above there is no need to establish a Wild Life Sanctuary at present.' Accordingly the writer informed the International Union for the Conservation of Nature and Natural Resources that this subspecies had been reported as extinct. But he as well as Lt.-Col. R. W. Burton and Shri P. D. Stracey (then Senior Conservator of Forests, Assam) continued their efforts to obtain further information and to protect the deer in the event of their being found.

Subsequently it was found that the deer did actually exist, and in October 1953 the whole of the Logtak Lake area was closed to shooting and declared a sanctuary by the Government of Manipur in order to protect it. Later on it was pointed out that it was unnecessary to close the whole of the lake to shooting as this deprived many *bona fide* sportsmen of their legitimate goose- and duck-shooting, and consequently in July 1954 the Logtak was opened to shooting—except the southern portion where the deer existed, which was made into a sanctuary of approximately 20 square miles (52 sq. km.) in extent. The area became reduced and in 1959 this Keibul Lamjao Sanctuary was surveyed and officially reported as being about 10¾ square miles (27.8 sq. km.).

IV. GEOGRAPHY AND ECOLOGY

Manipur, now a territory of the Indian Union, lies between Burma and the north-eastern portion of India, and consists of a valley area, which is surrounded by a hills area, between 23° 47′ and 25° 41′ north latitude and 93° 6′ and 94° 48′ east longitude. The broad open valley is about 750 square miles (1942 sq. km.) in extent, and about 2500 feet (762 m.) above sea-level; and a peculiar feature of this plain is the existence of many small hillocks dotted over the whole area. The hills area is about 7500 square miles (19425 sq. km.) in extent, rises up to some 10,000 feet (3048 m.), and consists of ranges of hills mostly running north and south.

The six large streams, as well as numerous small ones, which drain from the hills into the central plain, all combine to flow out again southwards through a narrow gorge into the Chindwin River in Burma. Consequently the southern portion of the valley contains a number of lakes and marshes, with variations in their conformation owing to changing flood levels and growths of reeds, grasses, and floating water weeds.

The Logtak is the largest of the lakes, and is over 25 square miles (64.75 sq. km.) in extent. Smaller lakes or *jheels* are dotted about, some of which dry up in the dry season either completely or with just a few pools of water remaining. A large part of the valley area is under a few inches of water during the rainy season, April to mid-October, and rice is extensively cultivated. The valley is not 'one huge swamp' as reported by Lydekker.

From figures given by D. B. Deb (1960) for Imphal, which is only 20 or so miles (*c.* 32 km.) from Keibul Lamjao Sanctuary, the average annual rainfall is 122 cm., and the mean daily humidity is highest in August with 81% and lowest in March with 49%. The maximum temperature is 34.44° and the minimum 1.66° Centigrade. Frost is common in the valley during December and January.

Keibul Lamjao Sanctuary consists of roughly 10 square miles (26 sq. km.) of 'swamp'. I have purposely enclosed the word swamp in inverted commas, because it must be explained at the outset that this is no ordinary swamp. It is a floating swamp. Tall reeds and grasses and other plants grow on a mat of dead or decaying vegetation; and this mat actually floats on the lake with approximately 1/5 of it above the surface of the water and 4/5 of it below.

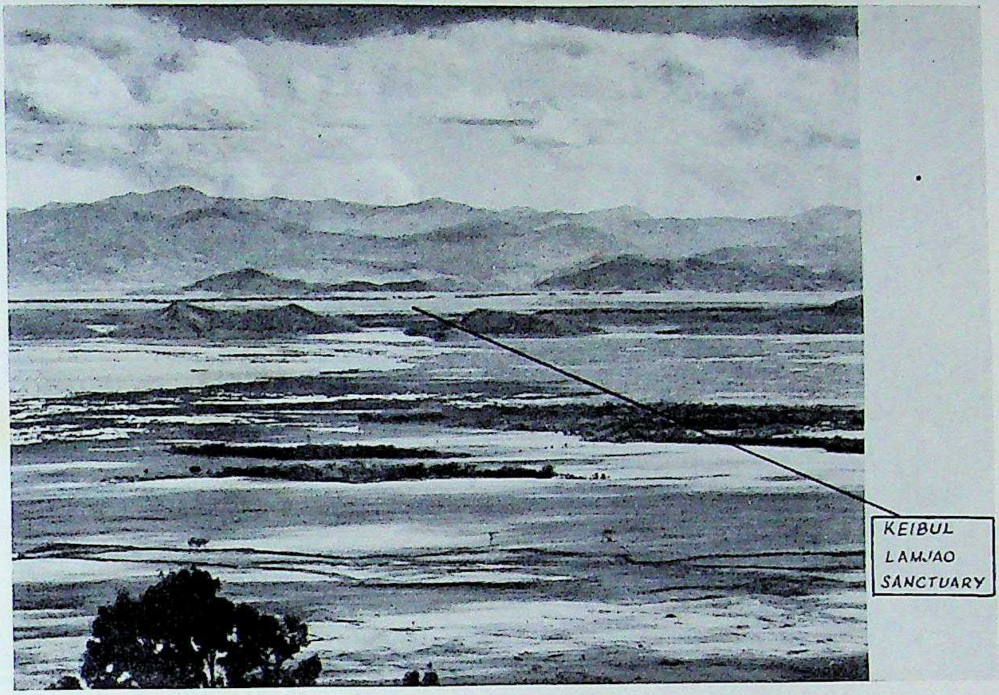
The extraordinary thing is that no sportsmen, naturalists, or other writers have recorded this fact before. Lt. Eld (1841) described the area inhabited by the deer as follows: 'Its favourite haunts are the low grass and swamps round the edge of the Logtak (lake) . . .' A. H. D. Barron (1911) mentions swamp. Lt.-Col. Alban Wilson (1924) refers to the area as a 'sea of grass'. Lt.-Col. C. H. Stockley (1928) describes it as 'grassy swamps', and goes on to say that 'poles are carried by which the *shikari* may ascend to spy, having stuck the end into the soft surface'. Even J. C. Higgins (1934), a naturalist of repute, wrote of this deer as being found in 'the swamps and bogs in the south of the Manipur Valley, and nowhere else in the State . . .'

Lt.-Col. H. S. Wood (1934) was a little nearer the mark when he referred to the floating islands of the Logtak Lake. He described this deer's habitat on the southern shore of the Logtak Lake as 'a huge morass consisting of dense reeds, grass, and water, and covered with algae and weeds . . . huge bog . . . here also were numerous floating islands, and during heavy floods I have found the deer leave them for comparatively dry ground at the bases of the low hills skirting the morass on the west.'

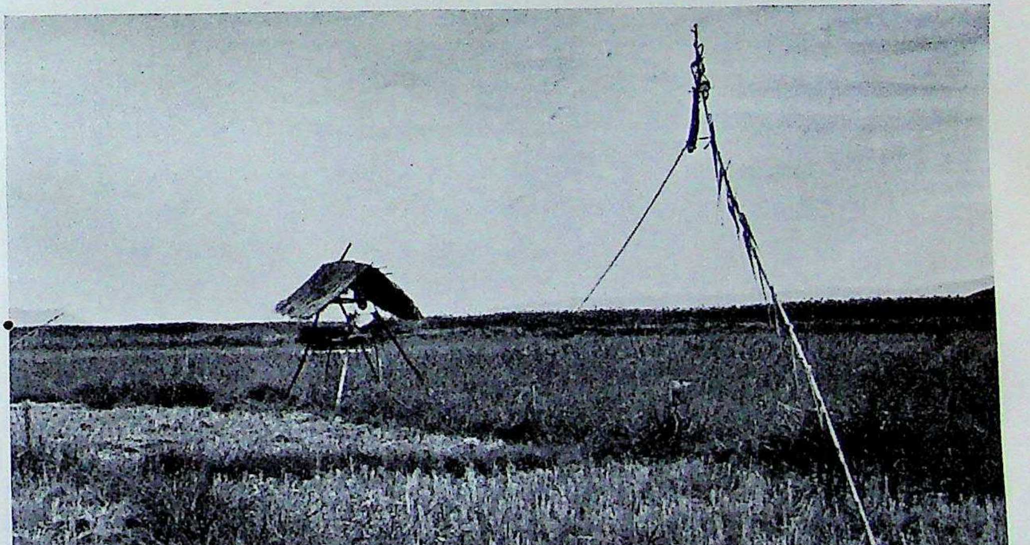
No one appears to have realized that the habitat of this deer near the shore of the Logtak Lake consists of what the Manipuris call *phumdi*. *Phum* or *phumdi* is a mat of organic matter in which reeds and grasses grow, often up to 15 feet (4.5 m.) or more. It is subdivided into *phumdi arupa* (sinking) and *phumdi ataoba* (floating). There is a seven-foot-long implement called *phumlen thangol* for cutting *phumdi* when a canal or passage is made. As mentioned before, *phumdi* floats on the water, with about 1/5 of it above the surface and 4/5 of it below. *Phumdi* varies in thickness from 6 inches (15 cm.) to about 5 feet (1.5 m.), and where it is thick a man can walk though he will sink to his knees or further in the soft mat. Should he accidentally tread on the mat where it is thin, he will go right through it into the water beneath.

Floating islands, floating bogs, or floating swamps are found, I understand, in Burma, the U.S.A. (at Minnesota), and in Britain (some peat bogs). Only the most enthusiastic of sportsmen went after this deer. To quote again from Lt.-Col. H. S. Wood: 'When stationed in Manipur from 1891 to 1898, I had exceptional opportunities of observing and hunting this deer . . . no other animal could exist in such swamps . . . The action of this deer is very peculiar. Instead of bounding with fore- and hind-feet coming on to the ground at the same time, it seems to be proceeding on its hind legs, the body being held almost vertical. This action prevents it from sinking in the quagmire . . . My method of hunting the Manipur stag was by stalking in this stuff, and if anyone wishes to attempt it, let him prepare himself for frequent duckings. It is very strenuous work and a torment owing to mosquitoes . . . My major, whom I took out one day, gave it up in the first few hundred yards after many cursings.'

A sportsman friend of mine who went after these deer in 1950 wrote to me as follows: 'From the point of view of making this a sanctuary in which visitors could see these animals I think it would

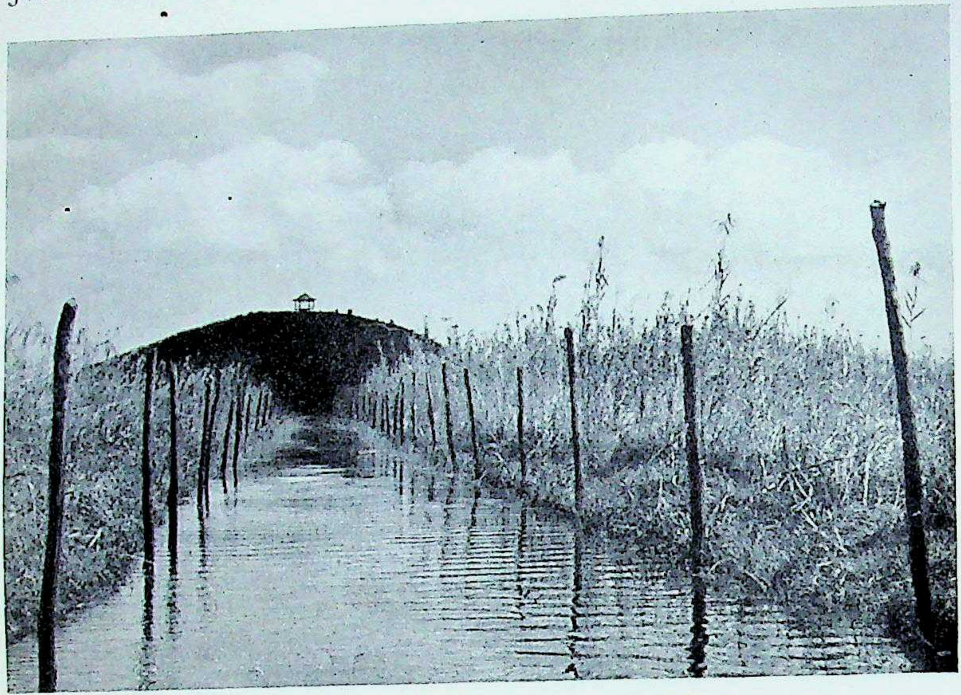

KEIBUL
LAMJAO
SANCTUARY

The Sanctuary as seen from the hill west of Bishenpur. Part of the Logtak Lake can be seen at the left of the picture

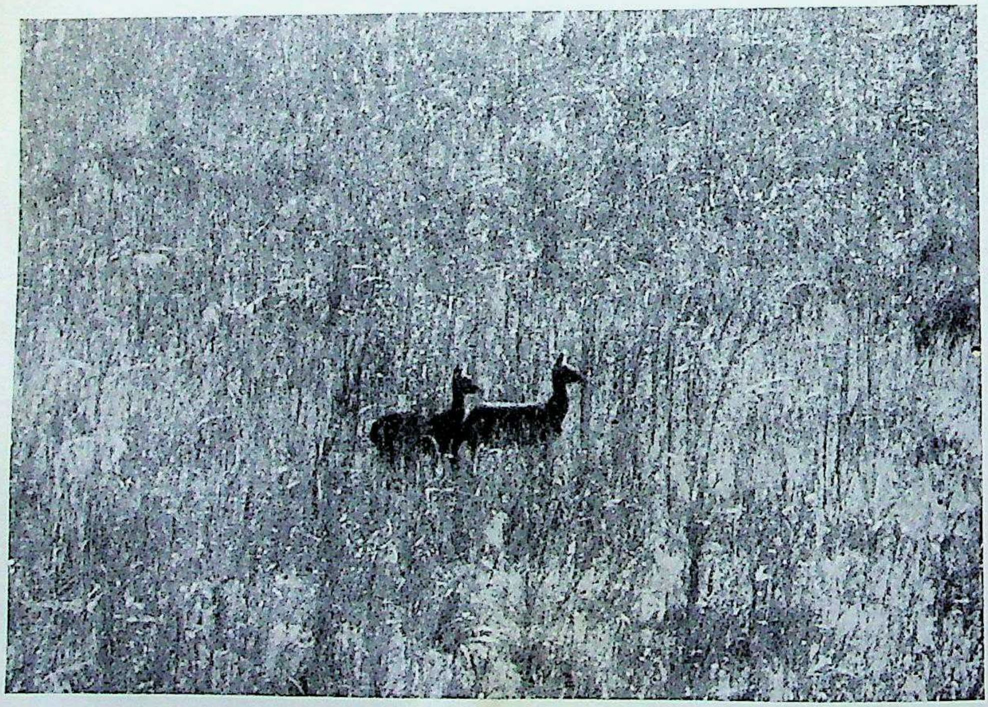


Shed and contrivance for driving away wild pigs from rice fields

Photos : E. P. Gee



Canal with observation hillock and tower



Hind and fawn Brow-antlered Deer photographed in Keibul Lamjao Sanctuary, March 1960

Photos : E. P. Gee

be a failure . . . it is terrible going, very deep swamps and one has to jump from hillock to hillock across deep ruts. If one should be unfortunate to fall in such a rut one goes in up to one's waist! . . . Again I can only repeat the difficulties of stalking these beasts. The going is *shocking* and they lie up in the most inaccessible places, often surrounded by bogs through which a man cannot pass.'

In places where the *phumdi* (of the *ataoba* or floating type) is non-existent, a reed locally known as *ishing kombong* (*Saccharum latifolium*) grows on the bed of the lake in the sinking *phumdi* (*phumdi arupa*), and approximately 5% of the area of the sanctuary consists of this. It is eaten by the deer and by domestic buffalo. The reeds and grasses which grow on the floating *phumdi* are as follows:

tou	*Phragmites karka*	45% of the sanctuary.
singut	(not yet identified)	25%
khoimum	*Saccharum munja*	15%
ishing kombong	*Saccharum latifolium*	5%
pulai	*Alpinia allughas*	5%
singnang	*Saccharum procerum*	2%
Miscellaneous		3%

There is no water hyacinth in the sanctuary area, except a very small amount near the edge. Presumably it cannot compete with the thick reeds and grasses which are listed above. The average thickness of the *phumdi* in the sanctuary area in October is about 3 to 4 feet (90 to 120 cm.), with about 4 to 5 feet (120 to 150 cm.) of water underneath. In time of floods this 4 to 5 feet (120 to 150 cm.) average would become 5 to 6 feet (150 to 180 cm.); while in March at the driest time of the year it would be 2 to 3 feet (60 to 90 cm.) or even less, and in very shallow places the *phumdi* would then be resting on the ground.

The small hilly area included in the sanctuary to the south-west is mostly denuded of vegetation by overgrazing by village cattle. To this high ground the deer sometimes move in times of very heavy rain which takes time to seep through the *phumdi*. As soon as this surface flooding of the *phumdi* has disappeared, due to the *phumdi* eventually floating again on the surface of the lake, the deer return.

Wild Pig and a few Hog Deer share this floating sanctuary with the Browantlered Deer. I was informed that Wild Dog do not and cannot exist in this area, but that occasionally a Leopard has been observed in it. Of bird life, only the smaller reed-dwelling species were observed. Larger wading and swimming birds appeared to be non-existent, as there are no open patches of water in the sanctuary.

There are villages all along the western and southern boundaries of the sanctuary, with large numbers of buffalo and cattle and with extensive rice cultivation. Cattle cannot enter the *phumdi*, but domestic buffaloes graze over about two and a half square miles (6.5 sq. km.) of the sanctuary. A strip of waste land along the western side of the sanctuary has been encroached on and cultivated, and a narrow wedge of approximately 60 acres (24 hectares) right inside the sanctuary has been cultivated by these villagers. Fishing from approximately 1000 narrow dug-out boats is done throughout the sanctuary area, along the narrow tracks where the *phumdi* is very thin or non-existent. From the end of the forest road to the edge of the sanctuary, to the hillock named Chinjao Hill on which the observation hut has been built, a canal has been cut through the 5 feet (152 cm.) thick *phumdi*. This canal is 15 feet (4.6 m.) wide, and 2800 feet (850 m.) long, and cost over Rs. 6000 (£450) to cut.

V. ADMINISTRATIVE AND POLITICAL

In the Manipur Administration, which is under the Chief Commissioner, the Secretary (Miscellaneous) has charge of the Forest Department. The Head of this Forest Department is the Chief Forest Officer, and the Keibul Lamjao Sanctuary has been placed under the Range Officer, Moirang, since January 1st 1959. The Forest Staff in charge of the sanctuary at the time of my two visits consisted of one Forester, one Forest Guard, and one Game Chaprassi.

In the last census the population of Manipur was given as (approximately) 600,000, of which 200,000 were in the hills area, and 400,000 in the valley area. Of these 400,000 in the plain, 200,000 were in Imphal town itself and 200,000 out in the villages. Since then the above populations have probably increased by 50% owing to natural increase and the influx into Manipur of displaced persons, Nepalis, and others. It will be seen, therefore, that the valley area is very thickly populated, and all the available land is under rice cultivation.

The Keibul Lamjao Sanctuary itself is flanked on the north-west, west, and southern sides by Thanga, Keibul, Kumbi, and other villages, the inhabitants of which are fortunately Manipuris who are vegetarian in diet and therefore do not hunt or kill the deer. To the north-east of the sanctuary however, there are the four Mussulman villages of Uchiwa, Mayang Imphal, Turen Ahaubi, and Samusang, whose inhabitants would (if given the chance) hunt and kill the deer. I was informed that no guns were possessed by any of the villagers.

Three offence cases, I was told, of 'encroachment in the sanctuary and of shooting animals' were detected and dealt with in 1955-56, and none in the subsequent years.

The fishing rights in the sanctuary area are auctioned annually; and were sold during the current year for Rs. 3000 (£225). Reed-cutting of *tou*, *singut*, and *singnang*, mainly on the eastern side of the sanctuary, was sold in two lots for Rs. 800 (£60) and Rs. 700 (£52/10). Fishing in small dug-outs in the sanctuary probably does not unduly disturb the deer, and may be regarded as a long-established 'right' of the local inhabitants with which it would be inadvisable to interfere.

Similarly reed-cutting is a local economic necessity and has been done since time immemorial, as the reeds are used for the building of walls of houses and as firewood; and the cutting and burning of reeds results in fresh growth, which is palatable to the deer. Incidentally, I found during my March visit that burning off of the reeds and grasses was only partially successful—unless they had previously been cut and left *in situ*. Cutting followed by removal of reeds and grasses would probably not facilitate burning, but would none the less produce new shoots.

Regarding the narrow strip of waste land along the western edge of the sanctuary, amounting to about one square mile (2.6 sq. km.) in extent, I was told that the villagers were claiming it and cultivating it, and that there had been some dispute between the Forest Department who wished to include it in the sanctuary and the Revenue Department who considered that it should be opened up for cultivation. I understand that it will now be difficult, if not impossible, to prevent cultivation here. There is a thin wedge of rice cultivation right in the centre of the sanctuary, amounting to some 50-60 acres, which should be stopped if possible.

I found that the local people, even educated persons, knew very little about deer and other wild life. The Mahommedan *shikaris*, who have for generations accompanied the sportsmen who have come here for goose-, duck- (and deer-) shooting, are the only people who have a working knowledge of 'game' animals and birds.

When I asked what were the reactions of the local villagers to the creation of the sanctuary, I was told that those people who were cultivating the strip of waste land along the western edge and the central thin wedge inside the sanctuary objected. Otherwise there were no adverse reactions except from those whose rice fields were raided by wild pigs from the sanctuary. The owners of the domestic buffaloes which grazed within the boundaries of the sanctuary would also probably protest if deprived of this facility.

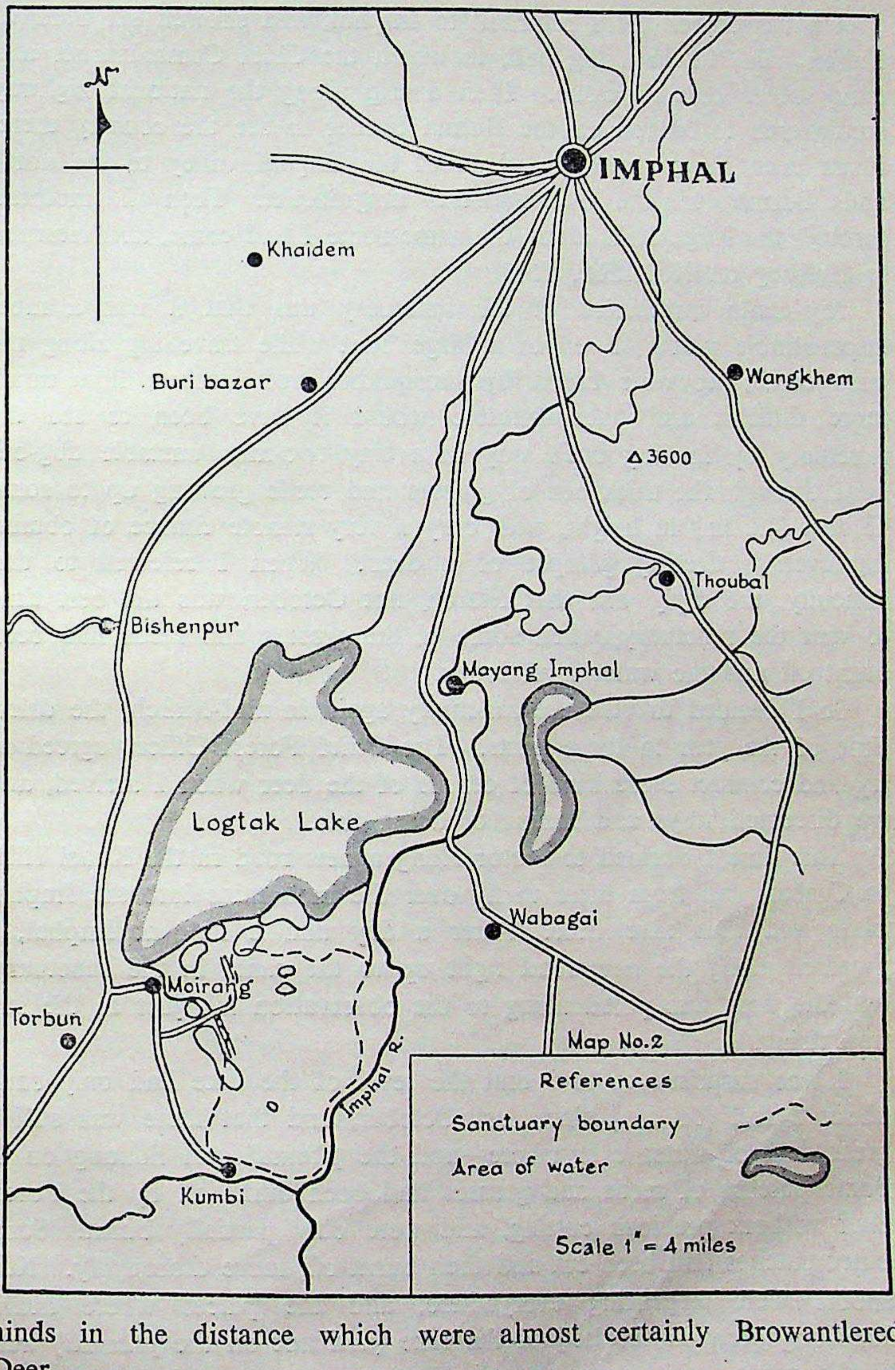
VI. GENERAL ACCOUNT OF THE SURVEY

First of all, a permit to visit Manipur was obtained—a formality obligatory on all who are not Indian nationals, mainly because of the Naga Hills being a 'disturbed' area. The fullest co-operation of the Forest Department had previously been offered to me by the Chief Forest Officer. On October 21st, at the end of the monsoon, I motored in my Land Rover (with trailer) to Imphal, via Kaziranga, Garyampani, Dimapur, Kohima, and Mao. From Dimapur to Kohima it was obligatory to travel in the daily armed military convoy, as the road to Manipur runs through the Naga Hills. One day was spent in Imphal in order to contact the Chief Forest Officer, and the Deputy Commissioner (who is Chairman of the Wild Life Board there). The nights of the 26th and 28th to 31st were spent at Moirang, which is 26 miles (41.8 km.) from Imphal and 4 miles (6 km.) from Keibul Lamjao Sanctuary—the object of my tour.

It was fine, sunny weather. The rice in the fields was still green, and the road to the sanctuary muddy after the monsoon rains. We saw many small sheds (*lousang*) in the fields for driving away wild pigs. At the end of the forest road to the sanctuary, a boat met us and took us along the canal through the *phumdi*. Numerous light brown mosquitoes and two leeches failed to discourage me. On arrival at the observation tower on the 150 feet (45.7 m.) high hillock known as Chingjao Hill, I found that a good view was obtainable of the sanctuary, which looked like a sea of reeds and grasses.

As it had taken us two hours to reach this spot, partly by Land Rover and partly on foot, and as it was only from this observation tower on the hillock that there was a chance of seeing anything, I decided to remain there all that day and for the night, in order to avail myself of evening and early morning opportunities of seeing deer. There were protests from the Forest Staff and villagers, about danger from wild pigs, about discomfort from mosquitoes, and above all about the existence of evil spirits at that place at night. These did not deter me, and I sent back for the necessary bedding and food.

Several wild pigs were seen during the day; and very early in the following morning one of the men accompanying me had a close view of a stag and a hind, and later another hind, near the canal. Afterwards, on being shown the antlers of a Hog Deer and of a Brow-antlered Deer, he unhesitatingly indicated that it was the latter that he had seen. In another direction I myself saw three light-coloured


N
IMPHAL
Khaidem
Buri bazar
Wangkhem
Δ 3600
Thoubal
Bishenpur
Mayang Imphal
Logtak Lake
Wabagai
Moirang
Torbun
Imphal R.
Kumbi
Map No. 2
References
Sanctuary boundary
Area of water
Scale 1" = 4 miles

hinds in the distance which were almost certainly Browantlered Deer.

The following days were spent in collecting information from the Forest Staff and from the local villagers. I visited Kumbi village on the south side of the sanctuary, and also the hill above Bishenpur for a view of the whole Logtak Lake area.

On November 1st I returned to Imphal, and showed six films of Indian wild life in a big hall, to which the Chief Commissioner and many other officials came. Then a trip along the national highway southwards to Moreh on the Burma border to see the country there. From near Tengnoupal the views of the Imphal valley to the north and Burma to the south were magnificent. Then I motored through the Naga Hills along the same route I had come, and returned to Shillong on November 8th.

My main impression of the sanctuary was that it was a most impenetrable place. Even in a large boat while travelling along the wide canal, we were bitten by mosquitoes and leeches; how much more difficult and uncomfortable would it have been to see the sanctuary by inching one's way in a tiny two-man unstable dug-out boat through the thick sea of grasses and reeds growing up to some 15 feet (4.6 m.) in height, with only a very remote chance of obtaining even a fleeting glimpse of a deer? When I referred to this difficulty, the reply was that March, not October, was the best time to visit the sanctuary, when some of the grasses and reeds had been burnt off and the water level lower.

So I decided to visit the sanctuary again in mid-March, the driest time of the year in these parts. The Chief Forest Officer agreed to try and conduct some kind of census of the deer when I arrived, and we discussed ways and means of doing this.

This time I decided to motor along a new road in the Khasi Hills to Cachar, and from there to fly over the mountains into the Imphal plain and thus save time. After a day and a half at Imphal, I motored along the new road right up to the canal in the sanctuary, and the boat was poled along to the observation hill just as the sun was rising.

I was surprised to find that the level of the lake had only sunk about 2 feet (61 cm.) since last October, and that there was still a great deal of water everywhere—and the *phumdi* still floating on it. Some patches of reeds and grasses had been burnt off by the Forest Staff without previous cutting, and were only partially burnt. Some other patches had been cut and then burnt off, more thoroughly. New shoots were appearing everywhere, and the places where *ishing kombong* grew in the bed of the lake (and not on the *phumdi*) were bright green with new growth. But, seen as a whole from the observation hill, the sanctuary still appeared to be a sea of reeds and grasses, with only small areas of open 'ground'. There was still a very great deal of cover for wild life, and hopes of doing a census of the deer rapidly faded away.

Carefully searching the area with binoculars, I saw a stag and hind Browantlered Deer about ½ a mile (800 m.) away, in the grass. In another place two half-grown fawns were playing, almost dancing round in circles, while their mothers grazed near by—unmistakably Browantlered Deer.

Twenty Manipuri villagers had been arranged to drive selected areas for conducting a census. These I decided to send out so that they could form a line and drive a representative area of about a quarter of a square mile (650 sq. m.) towards the hillock. I remained on the hillock with binoculars to observe results, as from the ground nothing can be seen except the grass immediately in front. The men denuded themselves of all clothing up to the hips, and set off—many of them with sticks to probe the *phumdi* for softer places in order to avoid a ducking. Soon they were all splashing their way through the black ooze which came well above the knees.

Out of this area came 4 Browantlered Deer, hinds and fawns, and 10 pigs. Two hours had passed by, and the men were not at all in favour of doing any more such drives in such heavy going. On the basis of this very limited investigation, I arrived at the following conclusion: The total area of the sanctuary was 10.75 sq. miles (27.8 sq. km.). Deduct from this the area grazed by domestic buffalo 2.50 sq. miles (6.5 sq. km.), the area of waste land and rice land under cultivation 1.00 sq. mile (2.6 sq. km.) and the hill area .25 sq. miles (650 sq. m.), and then 7 sq. miles (19 sq. km.) remained. At the rate of 16 deer per sq. mile (2.6 sq. km.), the total would be 112 Browantlered Deer in the sanctuary, say 100. Similarly 280, or say 300, wild pig also exist here.

The Indian Swamp Deer, *Cervus duvauceli*, does not exist and has never existed in Manipur. Barking Deer, *Muntiacus muntjak*, are found in the hilly, forested places. As for Hog Deer, *Axis porcinus* none were actually seen on my two visits to Keibul Lamjao Sanctuary. But evidence of their existence in the sanctuary is as follows: They are reported by Alban Wilson (1924) and Higgins (1934); a buck was killed shortly before my second visit at the edge of the sanctuary, and the head and antlers seen by the Range Officer; a head with antlers which had been found in the sanctuary was shown to me at the Beat Office of the sanctuary; and a pair of shed antlers said to have been found in the sanctuary was shown to me in Keibul village. Possibly some 25 Hog Deer exist in the sanctuary.

The Forest Staff in charge of the sanctuary and under the Range Officer of Moirang at the time of my first visit were as follows: 1 Forester (3 months there), 1 Forest Guard (10 years there), 1 Game

Chaprassi (3 months there). At my second visit, the first two of the above personnel had been changed, and I found: 1 Forester (17 days there), 1 Forest Guard (1½ months there), 1 Game Chaprassi (7½ months there). None of them appeared to have much knowledge of the sanctuary or of wild life.

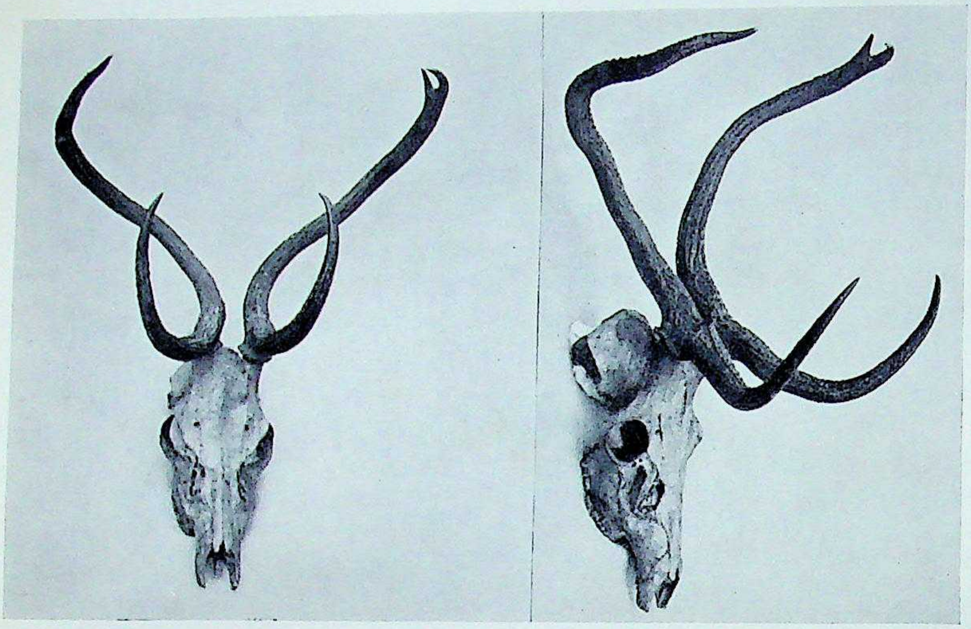
VII. STATUS, DISTRIBUTION, AND FUTURE OF THE BROWANTLERED DEER IN MANIPUR

FORMER AND PRESENT STATUS

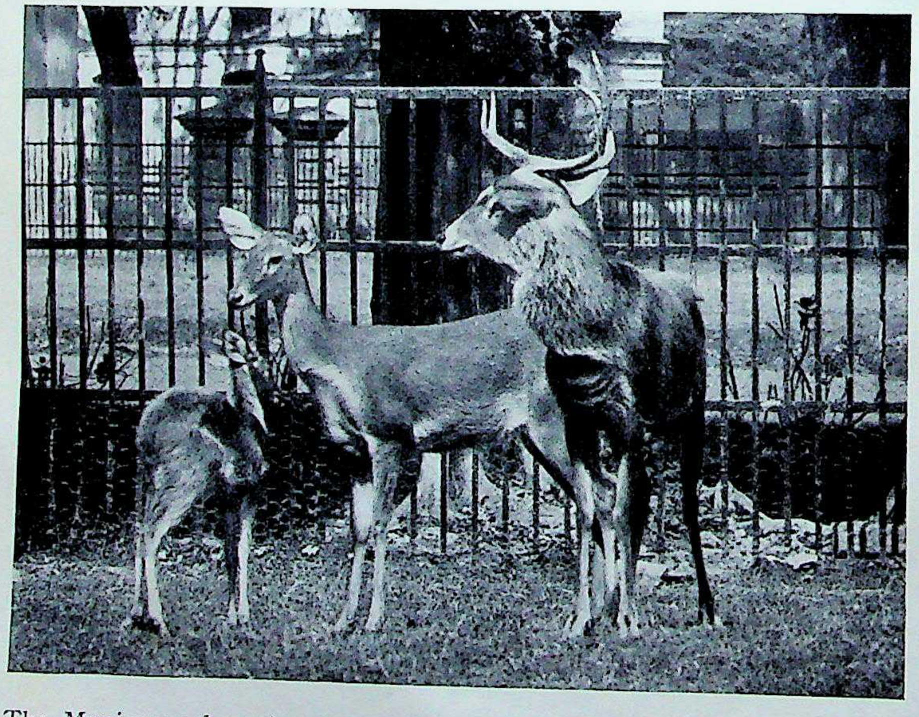
Information about the former range, distribution, and numbers of this deer in Manipur has to be searched for in the accounts given by sportsmen. In 1841 Lt. Eld wrote: 'It is gregarious in its habits, and after the annual grass burning, I have frequently seen herds of two or three hundred'. Lt.-Col. H. S. Wood, who was there from 1891-1898, recorded: 'Many years ago it was found in all the marshes of Manipur, but it was mercilessly hunted and trapped by the Mohammedan Manipuris, called Panguns, till we took over the State, when the Political Officer stopped all trapping . . . The Manipuri Deer is full of curiosity. The Manipuri name is 'Sangai' or 'the animal that looks at you', and exactly describes him . . . These deer are found in herds of six or seven, usually all does, the stag generally concealing himself very cleverly in the rushes and reeds . . . The Mohammedans kill them from dug-outs during floods, or spear them mounted on buffaloes. They also trap them by an ingenious method.' A. H. D. Barron in 1911 wrote of this deer that it '. . . keeps absolutely to the swamps, except perhaps during the rutting season, when he may be met in the long grass at the foot of the hills.'

J. C. Higgins (1934) stated: 'In the swamps it is fairly common, but, although nominally preserved by law, its numbers have decreased in late years, owing to the attentions of wild dogs and poachers. In times of high flood the wretched animals are driven out of their haunts to isolated pieces of high ground, where the neighbouring Nagas and Muhammadans take heavy toll, regardless of sex, age, close season or the rules directing the taking out of licences to hunt them.' I investigated the occurrence of wild dogs during my visits to this place, and was informed that these predators are now non-existent in the area concerned.

G. B. Eastmure has informed me in a letter that he was in this area in March 1947 and said: 'My experience of the Browantlered



Antlers of Manipur subspecies of Brow-antlered Deer



The Manipur subspecies photographed in the Alipore Zoo, Calcutta, in January 1960

Photos: E. P. Gee

Deer is slight, but I did spend four days out after a stag. In this time I saw several in twos and threes and two herds of about seven to eight beasts. The magnificent stag was seen through the glasses.' In 1951 these deer were reported as extinct, and then in 1952-53 were 're-discovered'.

I estimate that there are about 100 of these deer in existence today, confined to the area of the Keibul Lamjao Sanctuary, plus the stag, hind, and fawn in the Calcutta Zoo. I also consider that it is possible that this species may have formerly ranged over a larger area, including grassy undulating land at the foot of the hills, before being driven by increasing population and extending agriculture on to the *phumdi* of the Logtak Lake, which may after all be its present habitat by necessity and not of original choice.

FUTURE OF THE SUBSPECIES

In addition to being protected by law, this deer is protected by the impenetrability of its habitat and by the fact that most of the surrounding villagers are vegetarian Manipuris. In actual fact, its survival during the past 20 years had been due more to the last two factors than to any legislation. There is welcome evidence, however, that the present Manipur Administration is keenly interested in preserving the species; and the authorities deserve praise for steps already taken in creating and developing Keibul Lamjao Sanctuary. The new Public Works Department and Forest roads have made the sanctuary accessible by car. There are plans for re-afforestation of the small hills at the south-west corner of the sanctuary, and to construct a bungalow there for visitors.

In view of the fact that visitors have very little hope of seeing the deer in the sanctuary owing to its impenetrable *phumdi* conditions, there is a proposal to make an enclosure consisting partly of *phumdi* grassy area and partly of high ground grassy area near the site of the proposed bungalow (see Map 3). It is also proposed to re-afforest some of these over-grazed areas with *Salix tetrasperma*, a tree which is indigenous to these parts.

The above appears to be an excellent idea, especially as Brow-antlered Deer are known to do well in captivity. But it is questionable whether it would be in the best interests to have the enclosure at this place at the edge of the sanctuary, or to have it nearer Imphal—or even in the town of Imphal itself, in the form of a small zoological park.

With this latter view in mind, I accompanied the Chief Forest Officer to inspect two possible sites: One at Lamphelpat three miles from Imphal appeared unsuitable; but another possible site in Imphal near the D.M. College and next to the Imperial War Graves Cemetery on the main road from the airfield seemed to be a good one, as it consists of undulating grassland with some trees for shade. A third possible site, near Bishenpur where a botanical garden is proposed to be made, was also discussed.

Here it may be mentioned that Browantlered Deer have done well in captivity in various parts of the world. At Woburn Abbey, for example, the Duke of Bedford (1949) found that the species 'does quite well in confinement and with care could be preserved . . . Although several fawns were bred at different times, the herd received insufficient care and attention and was much reduced by 1914, when the war sealed its fate.'

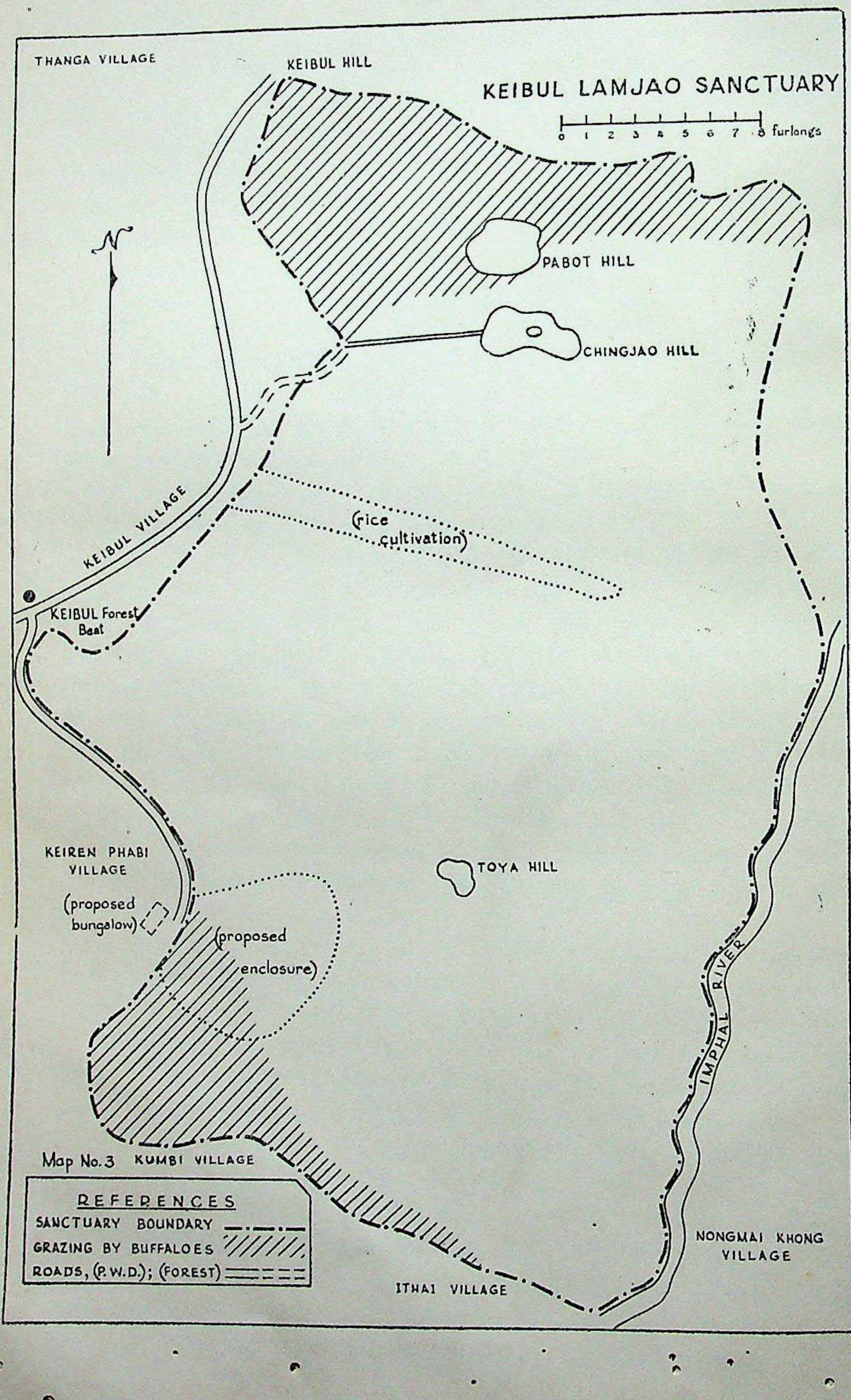
In the Regent's Park Zoological Garden of London, four fawns of Browantlered Deer were born during the years 1922-25.

In the Vincennes Zoological Garden of Paris a pair of the Thailand subspecies, *Cervus eldi siamensis*, obtained in 1937 multiplied to eleven by June 1954 when I saw them. They were in very good condition and were a very beautiful and graceful exhibit. Spots were still just visible on some of the adult animals. M. Nouvel informed me that the young are usually born in October and November, and that the period of gestation is 239 to 256 days. Maximum age recorded is 13 years. Stags commence to grow their antlers in August, and are in hard horn in December and shed their antlers in July. They mate in February. At the time of this report (July 1960) these deer in this zoo were 10 in number (2 stags, 5 hinds, and 3 fawns).

In the Rangoon Zoo, a pair of the Burma subspecies, *Cervus eldi thamin*, was presented in 1947 and by 1955 had increased to nine. In May 1960 there were ten of this subspecies still in this zoo.

In the Alipore Zoological Garden, Calcutta, deer believed to be of the *Cervus eldi eldi* subspecies did very well, and many fawns were born, in the years before World War II. In 1956 a pair of young animals was captured in Manipur and sent to this zoo, where fawns were born in October of 1958 and 1959.

It appears that stags of this deer, owing to the long brow-tine, are particularly susceptible to injuries—especially in the head. There have been several cases of this in the Rangoon Zoo. Even in the wild state this is the case, and Lt.-Col. Stockley (1928) wrote: '. . . the stags are most pugnacious, many being found blind of an


KEIBUL LAMJAO SANCTUARY
0 1 2 3 4 5 6 7 8 furlongs
N
THANGA VILLAGE
KEIBUL HILL
PABOT HILL
CHINGJAO HILL
(rice cultivation)
KEIBUL VILLAGE
KEIBUL Forest Beat
KEIREN PHABI VILLAGE
(proposed bungalow)
(proposed enclosure)
TOYA HILL
IMPHAL RIVER
Map No. 3
KUMBI VILLAGE
NONGMAI KHONG VILLAGE
ITHAI VILLAGE
REFERENCES
SANCTUARY BOUNDARY
GRAZING BY BUFFALOES
ROADS, (P.W.D.); (FOREST)

eye when shot. This is probably due to the position of the brow-tine. I once shot a stag which was entirely blind in both eyes.'

VIII. RECOMMENDATIONS (see Map 3)

The following recommendations are made:

(1) That the Keibul Lamjao Sanctuary be strictly protected as the only remaining habitat of the very rare Manipur subspecies of the Browantlered Deer. The following measures in particular are advised:

(*a*) Rice cultivation in the centre of the sanctuary should be prohibited.

(*b*) The question of the waste land on the western side of the sanctuary, at present unlawfully occupied by villagers, should be settled in the best interests of the sanctuary, and so as not to antagonise the local villagers.

(*c*) The grazing in the sanctuary of domestic buffaloes, if it cannot be prohibited, should be restricted as much as possible. The possibility of excising some of these grazing areas from the sanctuary area could be considered.

(*d*) Fishing and cutting of reeds in the sanctuary, if an established right and not preventable, should be carefully watched so that there will be a minimum of danger and disturbance to the deer.

(*e*) The numbers of wild pig should be reduced, when they raid the neighbouring rice crops.

(2) That the Forest Staff in charge of the sanctuary should be as permanent as possible, and under an officer of a rank not less than Deputy Ranger.

(3) That an ecological study be made of the deer in its unusual *phumdi* habitat.

(4) That, owing to the extreme difficulty of seeing the deer in the sanctuary, a few animals be humanely captured (departmentally) and kept in a suitably located enclosure. This measure should assist in preserving the animal, in increasing its numbers, in enabling scientific study, and in providing an attractive exhibit for visitors.

(5) That the Game Rules, published in 1958 as 'Preservation of Wild Life in Reserved Forests and other parts of Manipur', be revised and brought up to date.

(6) That steps be taken to ensure education and publicity in wild life and nature conservation, in order to arouse consciousness among the people of the cultural and economic value of wild life.

IX. ACKNOWLEDGEMENTS

Finally, I must offer my thanks to those officials and non-officials without whose interest and help my survey would not have been possible. The Chief Commissioner and the Deputy Commissioner both showed keen interest in the subject of preserving the Brow-antlered Deer, and both attended when I showed some cine films of Indian and African wild life. Mr. Goweahari Singh, Secretary (Miscellaneous) to the Manipur Administration, showed great interest in what I was doing, and paid a visit to Moirang in order to discuss sanctuary and preservation matters with me. Mr. S. Gambhir Singh, Chairman of the Imphal Municipality, was extremely kind and hospitable on every occasion I met him at the Manipur Hotel.

In particular I want to offer my thanks and appreciation to Raj Kumar Bijoychandra Singh, Chief Forest Officer of Manipur, who from the very start made all arrangements for my visits and assisted me with information and practical help in the way of transport and men to accompany me. To his subordinate officers—Rangers, Foresters and others—I also owe a debt of gratitude for all help rendered.

X. GLOSSARY OF LOCAL TERMS

Beat: (1) in forests, a sub-division of a Range, or (2) in shooting, a patch of jungle which is beaten for game, or (3) the actual beating of the forest for driving.

bil, bheel: small shallow lake (in northern India): see *jheel.*

chaprassi: a messenger or other such servant.

ching: hill.

huithou: wild dog.

ishing kombong: tall grass in water in sanctuary.

jheel: small shallow lake (in India): see *bil, bheel.*

kharsa: hog deer.

khoimum: tall reed grass with white tuft.

khunou: new village.

lamoak: pig.

loo: basket trap for fishing put down through holes in *phumdi.*

loukon: group of paddy fields.

lousang: small shed in paddy fields, for driving away pig.

mahal: an area (of forest etc.) leased out to contractors for commercial exploitation.

maril: course, way.

monsoon: annual rainy season,

pat: lake.

phumlen thangol: implement 7 feet long for cutting *phum* (*di*).

phum, phumdi: mat of organic matter, humus, in which reeds and grasses grow. (*P. arupa* sinking type, *P. ataoba* floating type.)

pulai: a plant (pigs eat it).

Range: a sub-division of a Forest Division, which contains a number of Beats.

Range Officer, Ranger: the Forest Officer in charge of a Range. (Deputy Ranger is next in status.)

sangai, shangai: Manipur subspecies of the Browantlered Deer, *Cervus eldi eldi* McClelland, 1842.

shabeng: goral.

shajan: sambar.

shaji macha: barking deer (lit. small deer).

shamu: elephant.

shikar: shooting, sport.

shikari: a sportsman who shoots, or a tracker for sportsmen.

singnang: grass in sanctuary.

singut: tall reed with brown tuft (cut and used).

thamin, thameng: Burmese for the Burma subspecies of the Browantlered Deer, *Cervus eldi thamin* (Thomas) 1918.

tou: tall reed (taller than *singut*) with brown tuft (cut and used).

turen: river.

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Some Notes on Sanctuaries and Wild Life in South India (1959)

BY

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Anyone now (January 1959) revisiting the Nilgiris after a lapse of 15 or 20 years cannot but be struck by the transformation that is overtaking the whole scene, particularly on the plateau itself. During and since the last war, there has been a steady increase in the area of land brought under vegetable cultivation, with its accompanying unsightliness. Natural forest cover is giving way to extensive tea, wattle, and eucalyptus plantation, and there is nothing uglier in the whole field of silviculture than eucalyptus farming as practised in the Nilgiris. Most important of all is the dam construction, both in hand and prospective. This in a few years' time will transform the higher parts of the plateau into a lake district, submerging many of the valleys formerly noted for their natural scenic beauty. The catchment areas of some of these reservoirs have already been very extensively afforested, also with wattle and eucalyptus. Thus, far and wide the characteristic and traditional Nilgiri scenery of downland and shola will soon have disappeared. Perhaps it will only be visible in the unspoilt natural state in the most inaccessible places and in those localities where special steps have been taken for its preservation. It is understood that some such steps have been taken to preserve the Wenlock Down area, the views over most of which are still refreshingly natural. But it is sad to find that there is already some infringement on what used to be one of the finest examples of a typical Nilgiri landscape, namely the view from the terrace of the Ooty Golf Club. Here the expanse of rolling downs and sholas spread, with scarcely a human habitation visible, as far as the eye could see on either hand, and receded into a distant background of higher peaks fading range after range in perspective. On a fine evening, with the setting sun breaking in slanting golden shafts through a scattered ceiling of cloud to throw a patchwork of light and shade over all, this was a view of unforgettable beauty. Now the squares of bare earth and red-tiled roofs, which denote the advent of vegetable cultivation, have started to creep in from both sides of the picture and the gaunt outlines of mutilated eucalyptus trees have begun to introduce the usual disfigurement. It is a pity, because this characteristic Nilgiri scenery, and this particular view in itself, was a great attraction to the visitors on whom Ooty thrives. One cannot help wondering whether, if most of it is destroyed, the inhabitants of Ooty and the Nilgiris will not have lost more than they have gained by destroying it. Also, is it really necessary to destroy most of it?

However, some developments of this sort are only to be expected as a result of the relentless pressure of expanding population from down below. Without doubt, they are for the greater part in the widest interests of the nation and, as such, one can only take exception to certain details of their implementation. The fact has to be faced that, in a few years' time, the aspect of the Nilgiri plateau or a very large part of it will be transformed. It will then be largely a region of chequered cultivation, man-made plantations, and artificial lakes, surrounded by afforested hills. Much of it will be opened up for the first time by a network of newly constructed motor roads with their accompanying infusion of 'civilisation'. So in due course any remaining tracts of natural scenery will probably be regarded as museum pieces.

Whether most of these changes will be for the good or not scenically is a matter of taste and opinion. Certainly, they will make for an interesting study in ecology which should well repay any research put into it. For when the hand of man is busy altering the face of the earth so intensively it is bound to have a pronounced impact sooner or later on the local fauna. Existing species may find the new conditions uncongenial and dwindle in numbers, or possibly even change their habits; species not at present represented may find the conditions to their liking and move in. There may even be scope for interesting (but one hopes cautious) experiments in the introduction of new species, particularly fish. All this should provide an absorbing and rewarding study in about 5 to 10 years from now and thereafter.

Meanwhile it is pertinent to take note of the current position of wild life on the Nilgiri plateau. It is a region which by its very nature cannot ever have supported the larger mammals in any real numbers; evidently, also, their numbers have always fluctuated considerably with the seasons and the local conditions. However that may be, the expansion of the human population and of the cultivated area has undoubtedly reduced the natural stock to a pitifully low level today. From all sides one hears that the existing protection laws have failed signally to check the inroads of poaching. It is arguable that they have also failed to afford the necessary protection through legitimately controlled shooting or fishing. To this there is one exception in the case of the Nilgiri Tahr (*Hemitragus hylocrius*) the protection of which appears to have been a notable success. But, in fairness, it must be conceded that both its habits and its habitat lend themselves to artificial protection; for it is an animal well able to look after itself, with natural haunts so far removed from human habitation as not to infringe on cultivated land and to attract the attention of only the most ardent shikari. Apart from the one case it cannot be denied that the present status of the larger and more interesting mammals is an extremely dismal one. What of the future? Unless there is a radical improvement in the efficacy of the protection laws and the efficiency of their enforcement, there seems little hope of improvement. It will be a great pity if something sweeping and imaginative is not done in the direction and done soon. For, to balance the spread of cultivation and the clearance of sholas, the extensive afforestation already referred to should eventually provide an over-all increase in the area of cover available for the larger animals. Whether all this artificial growth will be suitable to the needs of the native fauna can only be determined in the course of time and assessed by expert observation. If results are favourable the usual clash with the interests of agriculture and of stock farming will certainly arise. But to a great extent the newly afforested areas are fairly remote from cultivation and it should be possible, with properly framed and enforced laws and intelligent administration, to strike a happy balance between the requirements of the naturalist and the sportsman and those of the farmer.

As regards birds, here again the plateau is a region which does not freely support the larger species. But it is, or could be, a most interesting field for the observation of a large number of the smaller ones, varied and augmented as they are from time to time by local and long-distance migration. At the present time there is one species above all which forces itself on the attention of the visitor, namely the Jungle Crow (*Corvus macrorhynchos*). It is so noticeably abundant as virtually to replace the common House Crow (*Corvus splendens*) of the plains, both as a scavenger in the urban areas and as a forager in the country. From the ornithological point of view this is a sinister fact; for there can surely be no species so destructive to other and useful birds in the nesting season. One cannot help wondering at the beneficial effect on the useful bird population of the Nilgiris that would result from a drastic control of the Jungle Crow and all his works.

Of game birds, both the variety and numbers are strictly limited. Despite the presence of much and widely dispersed bog land, the occurrence of snipe (*Capella gallinago*) cannot be described as more than occasional, at least as the snipe population is reckoned in other parts of India. Where there has been inundation on a large scale, waterfowl of all kinds are conspicuous by their almost total absence. From this it can only be concluded that there is something lacking so far as birds are concerned in the water-borne food supply of the Nilgiris. So the prospect of the creation of a number of new lakes does not appear to hold out any promise for the future in this direction. The real target for the small game shikari in the Nilgiris is the Grey Junglefowl (*Gallus sonneratii*), which is both resident and locally migrant, and Woodcock (*Scolopax rusticola*), entirely a long-distance migrant. The changing conditions are hardly likely to favour the latter since the clearance of sholas will restrict the haunts suitable to their highly specialized needs and the increased incidence of human disturbance is likely to discourage them. For Grey Junglefowl, on the other hand, the spread of afforestation may possibly be beneficial. But, under the most favourable conditions, the status of both species can hardly in the nature of things become one of abundance. In addition to coping with their natural enemies they cannot be expected to stand up to concentrated and unrestrained shooting. Hence, unless intelligently-framed protection laws are effectively administered, they are bound to suffer even further depletion.

The present sadly depleted status of these game birds is sufficient evidence of the ineffectiveness of the existing laws and their administration. To the visitor these appear to consist of more fees to be paid and rules to be read than there are game birds to be pursued, while the means for enforcing all these regulations properly are very far from being apparent. To this day the writer, who scrupulously observed all the rules on his one and only fruitless outing, has not received back the deposit paid about a year ago as a guarantee for observing them. There may still be worthwhile sport for the local resident who has access to private land and who knows his way about intimately and the pitfalls to be avoided. But it is not a form of sport to be recommended for the visitor as things stand at present.

What the Nilgiri game laws lack in efficiency they try to make up for in comprehensiveness. But even if there did exist the wherewithal to enforce all these rules and regulations it is doubtful whether they would be effective. This is because they lack proper provision for controlling the frequency with which an area of land is shot over or a stretch of water fished. For the type of shooting and fishing with which the laws are concerned this is surely an absolutely essential requirement. At present there is apparently nothing to prevent a stretch of trout water which has been showing good results from being fished all day and every day by any number of rods indefinitely. This is undoubtedly a major cause of the trout fishing standard in most of the Nilgiri streams having sunk to its present abysmal depths. The same would apply to the junglefowl shooting.

If the country were to be divided into shooting blocks and the trout streams into fishing beats, and permits issued accordingly in line with the needs of conservation, it should be possible with adequate administration to exercise complete control of frequency on public lands and waters. This is a system which has worked very successfully for shooting in the reserved forests of the former Central Provinces and Bombay Presidency and for trout fishing in Kashmir, and there seems no reason why it should not be equally successful in the Nilgiris.

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When the main Mysore Road leaves the rolling, open downland of the Nilgiri plateau it starts the descent by curving and undulating through an area of thick, low-growing natural forest. It then emerges suddenly on the very edge of the mountain range to disclose a startling panorama over a drop of some three thousand feet with a horizon scores of miles ahead and on either side. This view on a clear day must have few equals in India, or anywhere else for that matter. At this point the Nilgiri Range descends, with a few rocky outcrops, almost sheer to the Mysore plain below. From its foot there spreads out an uneven green carpet of thick forest as far as the eye can see, to a backdrop of jagged peaks hazy in the far distance. Clinging to the escarpment's edge the motor road proceeds in serpentine fashion along the gentle gradients afforded by a well-planned alignment, through patches of forest and cool coffee plantations, until it suddenly unfolds into the straggling village of Gudalur. From there it pursues a comparatively straight and level course, but now through stands of the most luxuriant forest. At first massed clumps of giant bamboos overtop the road, their outlines plumed and feathery. These soon give way to thick tangles of vegetation presided over by towering evergreen trees partially excluding the light and imparting rather a sombre atmosphere to the scene. A cloistered silence prevails and there are few signs of life. All this betokens heavy rainfall and an abundance of retained moisture. But presently, as the climatic influence of the mountains recedes, a lighter, more open, and partially deciduous forest supervenes. Here at this time of day the only evidence of wild life is provided by frequent parties of langur monkeys (*Presbytis entellus*), feeding confidently along the roadside. But it does not require much imagination to realise that this whole tract of forest is an ideal habitat for almost the whole range of India's big game. In fact one is actually passing through the areas reserved by both the Mysore and Madras Governments for their wild life sanctuaries. The immediate objective is the rest-house provided by the Mysore Government for viewing its sanctuary of Bandipur.

BANDIPUR

The group of rest houses at Bandipur is ideally situated for their purpose, since although they lie within sight of the main road, only a few minutes' transportation takes the visitors into the heart of the forest. For transport the choice lies between a motor vehicle and elephant back. To have the best chance of seeing what one has come to see in the limited time available it is as well to try to cover as much ground as possible at the most likely times of day, namely early morning and late evening. So the choice inevitably falls on motor transport and instructions are given accordingly. Punctually, when the sun is well down towards the horizon, the vehicle presents itself. But it is very different from what was expected, being nothing other than an ordinary and rather elderly, light, commercial truck. It also carries an unexpectedly large crew, whose duties in relation to the job in hand are by no means clear. However, the expedition starts with a roar and a jerk and without much undue delay. Almost at once all traces of civilisation are left behind and the fruits of conservation in the shape of a plentiful stock of peafowl and jungle-fowl become apparent. But it also becomes apparent that the springs of the transport vehicle, if indeed there are any, have become well flattened out by violent use and abuse. The way lies over rough forest tracks which, though comfortable enough for a well-sprung passenger car, cause the truck, driven at some speed, to buck and sway like a launch in a choppy sea. Furthermore, the seating accommodation, which consists of hard, backless benches placed unsecured in the body of the vehicle, shows itself ill-suited for the purpose by bouncing and sliding about uncontrollably. Presently, the first herd of Chital (*Axis axis*) comes into view. There is much excited, but commendably silent, pointing by the crew. The brakes are jammed on firmly, causing the passengers and their benches to concertina quite indiscriminately against the driver's cab. The chital seem quite used to this sort of thing and continue grazing unconcernedly under the leadership of a finely antlered stag, their sleek dappled beautifully proportioned forms well shown up by the last rays of a setting sun. But this enchanting scene is quickly obscured by the truck's own cloud of dust catching up with it on a following breeze. So the expedition proceeds, bumping and rattling as before.

For the most part the forest is light and open, with many of the deciduous trees bare, thickened here and there by clumps of bamboo, and interspersed with grassy glades. There are occasional pools of water, on almost every one of which a pair of Spotbill Duck (*Anas poecilorhyncha*) is to be seen, thus showing how conservation of this kind can help preserve some of the larger indigenous game birds as well. But as a whole this tract of forest becomes too dry, soon after the monsoon is spent, to support the Elephant (*Elephas maximus*) and Bison (*Bos gaurus*) which every visitor comes to see and they have moved elsewhere for better grazing. Yet, as the truck winds over the many miles of track with which the Bandipur Sanctuary is provided, it is clear that a very satisfactory number of Chital (*Axis axis*) and Sambar (*Cervus unicolor*) is maintained. Also, their tameness is a tribute to the efficiency with which the work of conservation has been carried out.

Next morning, after a Spartan night spent on wooden plank beds, each as hard as a sacrificial slab, the expedition is repeated. The results are very much the same so far as the viewing of animals is concerned. But what is lacking in the variety of wild life is compensated to a great extent by the charm of the scenery. At this time of day the forest is lightly clad in early morning mist. This vanishes as the sun gains in power to reveal the wildness of the surroundings in a soft glowing light and the full grandeur of the Nilgiri Range rising abrupt and clear-cut from the horizon only a score or so of miles away.

For this excursion the visitors, their posteriors by now well chastened by the continuous impact of the unyielding benches, prefer to stand most of the day. With little on which to grip, this is not only a severe test of one's balancing powers, but involves the risk of being suddenly swept off by an overhanging branch or catapulted into the surrounding forest by an unexpected heave of the truck.

After a time, with the magic of early morning dispelled by the harsh light of day, this sort of progress begins to pall. A distant view of the rest house is quite welcome, especially as breakfast is known to be waiting there. Then, as if by way of a parting present, the forest with almost its last opportunity reveals a superb, lone sambar stag. Hearing the approaching noises it had paused frozen in its tracks to investigate. It stood stock still in a small glade only a stone's throw away, gazing back over its shoulder with its ears pricked forward in curiosity and its muzzle upraised as if to ease the burden of the thick, branching antlers. Soon it sensed the presence of humans and melted almost imperceptibly into the forest background, leaving behind a memorable impression on the minds of its viewers. The latter, though stimulated by this wonderful sight, disembarked a few minutes later with some relief. By now, they had that well-churned-up feeling which one usually associates with a session on one of those mechanical horses to be found in a ship's gymnasium.

MUDUMALAI

The next objective is the Mudumalai Sanctuary maintained by the Madras State, whose boundary marches with Bandipur only a few miles down the main roads on the way back to Gudalur. Although much the larger of the two in area, Mudumalai is apparently not well served by motorable tracks. So an evening excursion on elephant back is arranged. Incidentally, the camp of the Forest Department's working elephants is one of the most interesting sights in this area and, being located by the side of the main road, is easily accessible. But on this occasion all its occupants were still out on the day's work except one large, rather somnolent female with a very young and frisky calf at heel. There is not time to do more than strike up a passing acquaintance with these two since the riding elephant is already kneeling ready to receive its passengers at the rendezvous just up the road. In a very short time the party is mounted and away in the thick of the forest. And then the main advantage of an elephant ride over motor transport is at once apparent. For the way is now right off the beaten track, through the densest forest, up and down steep inclines and across unbridged watercourses. A steady, unhurried pace is kept up throughout regardless of the terrain. Being nearer the treetops there is ample time and opportunity for observing the smaller forest inhabitants such as birds and butterflies and also several giant squirrels whose habitat is only a little above eye level by this means of transport. The forest here is of a very different type to that at Bandipur. There is an abundance of lush grazing, a preponderance of evergreen trees, patches of dense undergrowth, frequent clumps of gigantic bamboos, and a sufficiency of water—in fact everything, seemingly, that should go to attract and support a good stock of elephant and bison. But, unfortunately, although there are many recent traces of the former, not one of either species is encountered in the limited compass of an elephant ride during the two hours or so before sunset. Such a brief excursion must always be chancy of results. Yet, even if nothing in the way of big game is to be seen, a ride on elephant back can never be really dull if one takes an interest in the behaviour of the mount itself as it makes a bee-line through every obstacle the forest can present. For an elephant moves its massive bulk with such fully articulated precision as to be fascinating to watch. The result is a smooth, silent, deliberate progress which gives the impression of every movement being carefully calculated, of perfect control over immense power, and of a capacity for almost unlimited endurance. There can be little doubt that the elephant is one of nature's most efficient products as well as one of her largest.

This one fills in the time and his stomach by nonchalantly plucking titbits from right and left without checking in his stride and stuffing them into his mouth, to be consumed voluminously as he continues on his way. Thus he makes a good meal without incurring the displeasure of his mahout, and finishes much more contented than his rather disappointed passengers, when the cavalcade returns to the starting point just as darkness falls.

After seeing these two sanctuaries a thoughtful visitor cannot help raising the question of how far they have been successful in achieving the objects for which they were instituted. What in fact are the main objects? There is first and foremost the object of pure preservation and in this it can be said at once that considerable success has been achieved. But almost equally important is the object of enabling the wild life thus preserved to be viewed and studied with reasonable facility and comfort by visitors, particularly foreign visitors, by which term I mean ordinary visitors and not those coming on a V.I.P. basis. For this purpose it seems fair to say that current arrangements do not go nearly far enough. In fact it appears that a golden opportunity is being missed to enlarge on this, and the following is intended as a constructive commentary from a foreign visitor's point of view.

In the first place there is the question of the way in which the sanctuaries themselves are at present constituted. It is understood that the Bandipur Sanctuary is only between 20 and 30 square miles (52 and 78 sq. km.) in extent. One hears that shooting is still allowed in its immediate neighbourhood and, on very special occasions, even the sanctuary itself. If this is so it seems a great pity and is difficult to understand. But even more surprising is the fact that the Mudumalai Sanctuary, although immediately adjacent to and part of the very same forest tract, is operated as a completely separate concern. This is because the entirely artificial political boundary between Mysore and Madras States happens to run through this forest area and each State apparently has to control its own sanctuary. Surely in a matter like this local political outlooks can be stretched to a broader national view, and an amalgamation effected into one centrally administered whole. It would of course vastly enhance the value of the whole project if in doing so the total area of the unified sanctuary could be suitably increased to about 300 sq. miles (780 sq. km.).

Then there is the question of the actual viewing facilities for visitors. Most of them are likely to have only a short time available. In such circumstances the best chance of seeing something worthwhile is by covering as much ground as possible during the most promising times of the day, which add up to a very few hours in all. This makes motor transport essential and presupposes that the whole sanctuary area is covered by an adequate network of motorable tracks. And there seems no reason why this should necessarily involve extreme discomfort. A freight truck can by no stretch of the imagination be held suitable for the purpose, particularly if special seating fitments are not provided. The noise alone that it makes goes a long way to defeat its purpose. The commoner animals, more accustomed to the presence of man, have evidently got used to it. But this may account for the fact that tiger and panther are so seldom seen by visitors. With their extremely acute hearing they can detect one of these approaching excursions from a great distance and make themselves temporarily invisible with the utmost ease. A jeep-type vehicle is surely the most suitable for this sort of work and two or three of them at the outside would cover all present needs. Also there seems no real reason why visitors so willing should not be allowed to take out their own cars if escorted. At the same time it should be remembered that in the world of Indian fauna the greater activity happens at night. By far the best way of viewing nocturnally is by construction of an elevated observation post over a water-hole on the lines of Tree Tops in Kenya. It need not be unduly elaborate, but in this forest would certainly have to be insect-proof. All this should not be taken to suggest that excursions on elephant back should be eliminated. They should certainly be retained, as a supplementary means of transport for those with more time at their disposal, or who are more interested in a close and leisurely study of the smaller forms of forest life, or who are intent on photography. Since in any case the Forest Department's working elephants are maintained here, this should not be difficult to arrange. Another aspect of this whole matter concerns the best means for ensuring that animals are attracted permanently to the sanctuary enclave in sufficient numbers and remain there as evenly spread as possible over the entire area. For at present there tends to be a distinct local migration in the dry season to follow the best grazing. The most likely means for dealing with this problem would appear to be the formation of more water-holes, the provision of artificial salt licks, and even suitable planting, if and where possible, in the drier zone of the sanctuary.

Finally there is the question of accommodation for visitors. At present this is about the most unsatisfactory feature of all. To begin with, application has to be made to a separate authority, each at a different place, for each sanctuary, with the added annoyance more often than not of dilatoriness in reply. As for the accommodation itself, at Bandipur it consists of three separate units at some distance from each other in a large cleared area. The largest of these is understood to be the former State shooting lodge, a portion of which still seems to be reserved for official purposes. That part of it which is available to the public is more suitable as accommodation for large family or other such parties than for casual visitors. The second unit of accommodation, the Forest Rest House, while well built, well situated, and clean, seems designed primarily to house officials on tour and is far from convenient for a number of visitors arriving in ones or twos and strangers to each other. The third unit, again situated at some distance from the other two, was at that time not yet ready for occupation. So far as could be seen it comes much nearer to actual needs in that a row of small bed rooms, each with a bathroom and a verandah, is provided.

But what should really be provided for a requirement like this is a compact arrangement of buildings on the hostel system, with a number of small double suites attached to a central lounge, dining room and kitchen. This would give not only the most suitable but also the most economically administered accommodation. At present even basic food requirements such as rice, vegetables, eggs, and milk are very difficult to obtain. If the supply of these could be organised, it would save visitors the inconvenience of bringing perishable foodstuffs as well as tinned stores.

At Mudumalai, a new rest house has recently been completed, the design of which is much more suited to the needs of the case and it is well situated to command a wonderful view over the forest towards the Nilgiri Range. But the number of rooms available seems inadequate, if the requirements of touring officials have also to be taken into account, in addition to those of visitors.

There is one more point on this subject of accommodation, a small one admittedly, but worth mentioning in the general context. Surely the interiors of rest houses in a wild life sanctuary are not suitable places for a display of trophies of the chase or of V.I.P.'s on shikar posed in front of their latest victims. Here more appropriately is an opportunity to display, suitably enlarged, some of the wonderful photos that have been taken of the living wild life to be found in this forest. In addition to their aesthetic value they would serve to promote the cause of conservation and also help uninitiated visitors to identify the various species which they are likely to see.

When it is time to leave this attractive and largely unspoilt forest, the return journey to the Nilgiri Hills is started with some reluctance. As the road climbs back to the plateau there is again revealed that wonderful panorama over the treetops just left behind. The visitor with an enquiring mind cannot help but feel that he has been shown only a part of what there really is to see. His disappointment is perhaps tempered by the hope that surely the authorities may in the not very distant future develop the full potential of this most interesting region as both a show place and field of research for the naturalist. In so doing they will reveal the true value of a fine national asset and there will be an immeasurable gain to all concerned if they do.

PERIYAR

The long established and now widely known Periyar Game Sanctuary is remotely situated from most of the more usually frequented centres of population. Perhaps this is as well and may account for a good deal of its attraction. But when someone genuinely interested really wants to see it, the journey thither represents something of a problem for those not actually resident in the far south. However, for the intending visitor from the Nilgiris there is a very direct and scarcely known route which is of some interest in itself. This lies from the foot of the Mettupalayam Ghat straight across the intervening plain to a locality where the foothills of the Annamalais and the High Range converge. From there a little used and rather neglected road starts to climb, at first gradually, then steeply, but always tortuously, into the hills. Very soon the asphalt surface, cultivation and other signs of a settled area are left behind. For several miles, the way is through a zone of scanty rainfall with resulting ragged scrub-jungle and scraggy deciduous forest. At times the road clings giddily and without a parapet to the sides of precipitous slopes with a drop of many hundreds of feet on one side. Quite suddenly, it straightens out somewhat into more fertile and well-favoured valleys and the first tea plantations appear. Finally another steep climb up and over, debouching into scenery reminiscent of Scotland, brings the traveller after many winding miles to Munnar, the capital of the tea industry in the High Range. From there onward, the road leads through scenery of an entirely different character. Once the orderly green ocean of tea has been left behind, it plunges into a jumble of low hills and thick tangled forest, long stretches of which have been adapted to cardamom plantation. This is real elephant country. In some ways it would be the most interesting part of the whole trip if only the condition of the road gave the opportunity to enjoy the surroundings. As things are, it is quite a relief to reach Thekkady, the nearest inhabited place to the sanctuary.

The hostel on the Periyar Lake is self-contained in that advance booking can be accepted on the spot, comfortable and fully-equipped accommodation is available, and full feeding arrangements are provided. There is thus a vast improvement over the Madras/Mysore organisation in this respect alone. It is situated on the very edge of the lake which forms the core of the sanctuary and within a few minutes of arrival a launch trip is booked for the same evening. It merely remains to fill in the intervening time with rest and refreshment.

It is only a hundred yards (90 metres) or so from the hostel down to the landing stage. When the launch pushes off, the surrounding scene is flushed with mellow evening sunlight, most stimulating to the anticipation of prospects ahead. One does not have to go very far to realise why this is such an admirable place for viewing wild life. For when a dam was thrown across the Periyar River it formed not one vast expanse of open water, but a series of long channels reaching up narrow valleys through the surrounding hills. The result is that a boat is seldom more than a hundred yards or so from the shore on either side and anything near the water's edge is clearly visible to the naked eye. In places, towering, untouched forest comes to within a few yards of the lake with rich grazing along the verge. Elsewhere grassy slopes of varying steepness rise to a few hundred feet, their folds and gullies thickly wooded. The water channels wind and bend, so that it is frequently possible to get surprise views by coming round a corner suddenly without being seen. It is hard to imagine a more convenient arrangement for observation and all from the comfort of a launch. In these respects the Periyar Sanctuary must surely be unique.

But on this particular evening there is not much to be seen. Especially there is a strange absence of birds, and of water birds there are scarcely any visible at all. As the voyage gets well away from the inhabited end of the lake, sambar appear regularly, sometimes in numbers, grazing high up in the open. They seem to favour the extensive patches of burnt grass, presumably attracted by the lush new sproutings, but incidentally making themselves almost invisible against the dark background. The single master stag seen was lying down on one of these burnt patches and could only be spotted for certain by careful focussing with the binoculars.

A sharp turn leads to the dam itself, and the only sizeable expanse of open water. On the far side steep grass-covered slopes lead up to the highest peaks that border the lake. There is a large rock-like object protruding from the grass far up above the water here. Is it a rock or not? The binoculars seem to confirm that it is. But there is something unusual about it and further scrutiny by eye convinces that there has been some sort of movement. Again the binoculars are brought to bear and there is no mistake about it this time. It is an elephant all right—a flapping ear gives it away. It is standing knee-deep in grass, surrounded by such an abundance of food that it scarcely needs to move in gathering its evening meal. Now that the outline is familiar a second one is spotted, lower down and browsing at the edge of a thicket. The launch is stopped and for several minutes the party watch intently and unobserved. Then the dipping of the sun below the horizon warns us that it is time to go and the launch is turned homewards. The light is too poor now to see much but a glimpse is caught of a lone bull bison at the water's edge. He is very much alert and fades into the forest with an ease that is astonishing for so large an animal. Further on, there is a simultaneous though distant view of a herd of bison cows with calves and a large sounder of pig, all within sight of the Travancore State Lodge. It is dark when the landing stage is regained.

Very early next morning the trip is repeated. It is half light when a start is made and ragged wisps of mist still cling to the higher parts of the forest; most of the peaks are shrouded in cloud. Over all there is calm and silence, broken only by the hoarse purring of the launch's engine. Ten minutes or so pass uneventfully and then, as if by arrangement, out of the forest just ahead and close to the shore, steps a magnificent bull bison. He is facing the other way, so has not seen, and somehow has not heard, the intruders. The driver has the sense to stop the engine at once and the launch glides silently under its own momentum almost level with the object in view. At a range of about 50 yards (45 metres) every detail of the bison can be observed, his huge, hunched shoulders and shapely hindquarters, the powerful muscles rippling under his sleek, chocolate-coloured hide, the smart white socks and twitching tail. Presently something prompts him to turn his head giving a view of the massive, curling horns. A brief pause and gaze, dilated nostrils, and then, not satisfied with what is to be seen, he is gone as silently and suddenly as he appeared. The party resume their voyage exhilarated and fully confident that this morning their luck is well and truly in. Yet although they cruise around far and wide for an hour or so nothing further of any sort is seen. So a course is set straight back to the hostel with all thoughts on the breakfast waiting there to the exclusion of everything else. Then, as often happens on such occasions, the sight for which they have been hoping and searching unexpectedly presents itself. In passing a long narrow inlet 3 elephants are spotted disporting themselves on the open shore. The helm is put hard over, speed is reduced, and the stalk begins. But the elephants have heard them and take speedy evasive action. To make up for this the launch comes suddenly on a party of cows with very young calves, all hitherto unseen on the opposite bank. These stand nervously huddled together in long grass, with upcurled trunks searching the air like some sort of radar equipment, and their offspring shielded by their bodies. The visitors are watching this interesting family scene when something much more exciting comes into view. At the head of the inlet on a wide grassy level, well away from the surrounding trees, stands a giant solitary tusker. Except for a gentle swaying of his trunk he stands quite motionless as if meditating on a full stomach and wondering what to do next. Against the background of sweeping grassland and wild forest, with distant cloud-capped peaks where the morning sun is just breaking through in downward-slanting beams of light, there is something primeval about this scene which stirs the imagination. The visitors watch enthralled until their departure can no longer be delayed, leaving the tusker to his thoughts.

What are the reflections on a visit like this to Periyar? The facilities provided for visitors go a long way to meeting justifiable requirements. At the hostel the accommodation, service, and food set quite a satisfactory standard. Nevertheless, the sleeping accommodation at present available could with definite advantage be supplemented by additional single and double rooms, which need not be large. There should not then be undue congestion with the arrival of sizeable parties in addition to the usual casual visitors. But is it necessary to have the windows of the hostel so heavily protected with thick, vertical, iron bars? In the larger rooms they give one the impression of being caged and in the smaller ones of being confined in a prison cell. The compound is already guarded by a special ditch sufficient to keep out most animals and it is understood that the additional window protection is to guard nervous visitors from over-inquisitive and perhaps hungry carnivora! If they really must be so protected there are several kinds of window guards on the market in artistically wrought designs which would be equally effective. Then again, although the hostel is well situated on a promontory overlooking the lake, it is completely screened by trees from an exceptionally beautiful outlook. This could surely be improved by judicious felling and clearance without in any way spoiling the scenery as a whole. Certainly the attractions of the hostel would be immensely increased thereby.

While the transport arrangements for viewing are as efficient and comfortable as one could reasonably wish, there would be a great improvement if the launch engines were to be fitted with silencers. This would much enhance the prospects of seeing the more wary animals, particularly the carnivora. At present too much depends on the driver's promptness and commonsense in switching off or throttling back when something comes into sight.

Finally, how efficient is the organisation for ensuring the actual protection of the wild life in the forest surrounding the lake? The visitor does not usually set foot on shore so it is impossible to see for one's self. If it is as efficient as the arrangements for protecting the visitors in the hostel, well and good. Yet there are disquieting rumours of rampant poaching. Certainly the behaviour of many of the animals seen, especially the bigger ones, indicated anything but confidence in human beings. Although on this particular visit almost everything was seen that one could reasonably hope to see in so short a time, reports from other visitors give the impression that this may have been due to pure luck. This should not be in a sanctuary with so perfect a setting and with such admirable facilities for viewing. One can only hope that the authorities concerned are fully alive to the need for the strictest, most efficient, and comprehensive enforcement of protection over the whole area. Otherwise what is, in its way, undoubtedly a national asset of the very greatest, and possibly unique, value will in a short time just wither at the roots.

Obituaries

S. P. AGHARKAR

The world of Science in India, and of Botany in particular, suffered a great loss early in September 1960 by the death at Poona of Dr. S. P. Agharkar at the age of 76.

Dr. Agharkar obtained the B.A. degree with Biology from the Elphinstone College, Bombay, and was placed in the first class. He also had the distinction of being awarded the Wordsworth Prize in English. Subsequently, he went to Germany, where he had the privilege of working under the famous botanist Prof. Engler. He obtained the Ph.D. degree with credit, but the outbreak of World War I prevented his return to India. On the termination of hostilities, he came home and was appointed Professor of Biology in the Elphinstone College. It is interesting to note that his earlier work was concerned with zoological problems, which included the discovery of the first freshwater medusoid in India, *Limnocnida indica* Annandale.

Dr. Agharkar was appointed Bose Professor of Botany in the Presidency College, University of Calcutta, where he worked for 25 years till his retirement in 1941. In recognition of his services to science, the Royal Asiatic Society of Bengal awarded him the Indian Science Congress Medal in 1944.

Dr. Agharkar was a man of varied interests. He has held the offices of President and Vice-President of the Indian Botanical Society. He was the General Secretary of the Indian Science Congress Association for several years, and enjoyed the unique distinction of being the President of the Botany Section of the Indian Science Congress twice. He was Vice-President of the National Institute of Sciences for a number of years, a member of the High Altitude Commission appointed by the Government of India for the investigation of flora, a member of the Managing Committee of the Indian Central Jute Committee, President of the Indian Ecological Society, etc. His accurate knowledge of the laws and by-laws of various bodies and institutions, and of constitutional rules, enabled him to render great service to all the bodies with which he was associated.

After his retirement from the Calcutta University, he settled at Poona, where he founded the Maharashtra Association for the Cultivation of Science on the lines of the Bengal Association for the Cultivation of Science. This Association has been tackling a number of problems relating to rice, fibre-yielding plants, mangoes, betel-nuts, bananas, etc., under schemes sponsored by the Central and State Governments. One of Dr. Agharkar's magnanimous gestures was the donation of his personal collection of rare books to the library of the Calcutta University, and of important books on Botany worth Rs. 60,000 to the Maharashtra Association for the Cultivation of Science. He joined the Bombay Natural History Society in 1908 and, though the membership lapsed during his detention in Germany, he rejoined in 1948 and served actively on the Executive Committee from 1954 until his death.

Dr. Agharkar was one of the most amiable of men, and his ever-present smile was an assurance of the joy with which help and advice were given to all who approached him. His dynamic personality will be missed by all scientists and particularly by botanists. By his death the country has lost a profound scholar, an indefatigable worker, and one of its prominent scientists.

B. S. NAVALKAR

C. H. DONALD

We are sorry to have to record the recent death of Mr. Charles Hilliard Donald at Dornoch, Scotland.

Born in India in 1873, Mr. Donald belonged to a family which has had a long association with this country. He was educated at Bishop Cotton's School in Simla and George Watson's College, Edinburgh. On his return to India he joined the Sutlej Forest Company of which he became the managing partner.

He joined the Society in 1896 and was actively associated with the first attempts at the preservation of wild life and fisheries in the Punjab and travelled widely in the Himalayas. In his younger days he was a keen falconer, and was perhaps the first person to have tamed and trained a golden eagle. His main interest was the study of the birds of prey and he contributed several valuable papers on this subject to the Society's journal—the last on 'The Flight of Eagles' in the special fiftieth volume.

He retired in 1932 but stayed in India till 1947. In 1945 he was elected an honorary life member of the Society in recognition of 50 years of keen and valued association with the Society.

In addition to his work on the birds of prey, he was also the author of a book on the training of gun-dogs, which hobby he continued after his retirement in England—his chocolate-coloured Labradors being wonderful examples of his patient training.

With his death we lose one of the oldest members of the Society and another link with the British residents who have done so much for the study of natural history in India.

We extend our heartfelt sympathies to Mrs. Donald.

EDITORS

STANLEY HENRY PRATER

(*With a plate*)

Stanley Henry Prater, whose name was almost synonymous with the Bombay Natural History Society for nearly a quarter of a century prior to his retirement from its curatorship in 1948, died in London on 12th October 1960 at the age of 70, after a long and crippling illness. He was born on 12th March 1890 in the Nilgiris (south India), the son of William Prater, a coffee planter. He was entered at an early age in St Mary's High School, Bombay, then conducted by Jesuit fathers of the German mission. From his early years most of his school holidays were spent at Khandala in the Western Ghats, and it was but natural that the first sparks of the boy's interest in natural history should be kindled by such surroundings. They were fanned into a steady flame by the sympathetic encouragement he received from the fathers, some of whom were distinguished naturalists. The main influences on his future career were those of Frs. Dreckmann (snakes), Assmuth (termites), and Blatter (plants). Them he always remembered and spoke of in later life with great reverence and affection.

Prater joined the Society's service in 1907, first working under the guidance of E. Comber, and later as assistant to the Society's first stipendiary curator N. B. Kinnear, afterwards to become Sir Norman and Director of the British Museum (Natural History). In 1923, Prater was appointed Curator of the Society and of the Natural History Section of the Prince of Wales Museum of Western India, Bombay. This position he held with marked distinction till his retirement in 1948 owing to his election to the Indian Constituent Assembly in New Delhi as a representative of the Anglo-Indian community, and the wholetime attention to politics and the frequent absences from Bombay that this would entail. To qualify him for the charge of a really first class natural history museum, worthy of the First City in India and of the Bombay Natural History Society, Prater was deputed by a far-sighted Board of Trustees in 1923 to the United Kingdom to learn the art of modern taxidermy in the studios of the well-known taxidermist L. C. Harwood. In 1927, he was again sent abroad, this time to the foremost museums in the United Kingdom and America, to pick up the techniques of modern natural history museum exhibition—the preparation of habitat groups or dioramas which, starting in Germany, had reached perfection in the United States, particularly in the American Museum of Natural History, New York, and what was then the Field Museum of Chicago. The fruits of his skill and aptitude are evidenced by the artistically designed galleries of the Natural History Section of the Prince of Wales Museum, Bombay, and the superb group exhibits, acclaimed to be the finest in the East.

This era of the Society, between the years 1923 and 1937, during which the new natural history wing was conceived, designed, erected, and opened to the public, was one of outstanding progress owing to the dynamic combination of two dedicated and far-sighted personalities, Sir Reginald Spence as Honorary Secretary of the Society and Chairman of the Board of Trustees of the Prince of Wales Museum, and S. H. Prater as his able and versatile executive. The Natural History Section is indeed a standing monument to Prater's genius. Not only the best use of his training abroad, but the gift he possessed for passing on the full benefit of his knowledge and experience to his co-workers and staff, and his tact and ability to extract whole-hearted co-operation from them, enabled him to achieve the highest results. He was fortunate in having an exceptionally competent and dextrous lieutenant in Charles McCann, who readily lapped up the imported techniques, adapted them to local conditions, and put them into masterly execution in the museum's galleries.

For the last 27 years of his service, Prater was the executive editor of the *Journal of the Bombay Natural History Society*. The high standard which the *Journal* attained during this period earned it international recognition as the foremost natural history journal in Asia. He was a voracious and discriminating reader, particularly of natural history books, in his early years. Reading, writing, painting and plaster modelling were his favourite hobbies during his retirement. The skill and discernment with which he would browse through heavy scientific literature, and the facile manner in which he would then connect up and expound disjointed facts, culled from many sources, and produce harmony from them were enviable. So was his rare capacity for picking out the essentials of anything he read, sorting out and assimilating complicated scientific data, and clothing the substance in simple, jargon-free language for the layman. He was blessed with a remarkably retentive memory, and could usually lay his hands on anything he had read on a subject, may be years before, without hesitation or fumbling. Prater excelled in the art of compilation ; he wrote in a readable, easy, and often humorous style, was a good illustrator with pen-and-ink or brush, and a frequent and welcome contributor of popular natural history articles to numerous journals and magazines. The bibliography of his principal contributions in the *Journal*, given below, conveys some idea of the wide range of his interests and versatility. The realization of

Stanley Henry Prater

the crying need for wild life preservation in India was brought home to the public and to the government largely by his able exposition in the introduction to the admirable series on Wild Life Preservation in India which he initiated in the *Journal* in 1935, and by his constant ' plugging ' of the problem through numerous well-informed editorials in the *Journals* and newspaper articles, before and since.

The familiarity he acquired with the Society's natural history collections during his long stewardship gave him a wonderful all-round grasp of Indian animals. Though his own leanings were more particularly towards mammals, birds, and snakes, he was quite at home with almost all other groups and could not only name straightaway practically any specimen brought in by members, even of the less common animals, but usually also give their distribution and habits. His intimate connection with mammals during the Society's Mammal Survey between 1911 and 1923, both as field collector and while handling the specimens as they came in from the field, or back from the British Museum after identification, gave him a particularly good knowledge of mammals. This, no doubt, accounts largely for the authenticity and success of his THE BOOK OF INDIAN ANIMALS published by the Society in 1948. During the mammal survey field work he suffered a serious accident which might well have cost him his life. A gun went off when picked up by the trigger by his local assistant and blew away a large part of his thigh. The injury, though it healed remarkably, incapacitated him for further strenuous field work, and from this time on his activities remained chiefly intra-mural.

Sir Reginald Spence first initiated him into politics so that he might be of service to his Anglo-Indian and Domiciled European community, then in need of able leadership. Prater took up his new avocation with his customary conscientiousness and gusto. The well-informed manner in which he handled all legislative problems, particularly educational, and participated in debates, whether concerning his own community or the public at large, made his opinions respected in government as well as opposition circles, and he was drafted on numerous important committees including the Provincial Franchise Committee and the Greaves Committee on Education. For 17 successive years he was the President of the Bombay Presidency Branch of the Anglo-Indian and Domiciled European Association, which he ably represented in the Bombay Legislative Council before Independence.

Among his other public activities, he was a member of the Provincial Board of Education, and of the Managing Committee of St. George's Hospital, Bombay, and a Justice of the Peace. In 1943 he was awarded the O.B.E. for meritorious services in various fields. His good standing and friendliness with persons of every shade of opinion, political and otherwise, and the confidence he commanded with the ruling party in the Legislative Council, were an asset to the Society from which it profited in many indirect ways.

Prater was, in truth, a remarkable man—capable, versatile, sociable, ambitious, and a striver after perfection as his many handiworks clearly show.

As friend, companion, and colleague, he was good natured and tolerant, and possessed of a keen sense of humour which never left him even in his last bedridden years. His sociable disposition and considerateness for his dependants and subordinates endeared him to all who came in contact with him. He will enjoy an honoured place in the Society's annals as one of its most stalwart and capable builders.

Appended is a list of the more important of Prater's contributions to the Society's *Journal*. His only book THE BOOK OF INDIAN ANIMALS illustrated by himself, is out of print, but a second edition is in preparation. Besides these, he wrote the section on the fauna in Percival Landon's NEPAL published in 1928.

S.A.

MAMMALS

1. Notes on Wroughton's Free-tailed Bat (*Otomops wroughtoni*). **22** : 788.
2. Note on a stranded Great Indian Fin Whale (*Balaenoptera indica*) at Ratnagiri. **23** : 576.
3. Progress of the Mammal Survey. **26** : 656, 1036.
4. An old time buffalo hunt. **27** : 627.
5. Record Panther Skull (*F. pardus*). **27** : 933.
6. The Tsaine. **28** : 786.
7. The Slow Loris (*Nycticebus coucang*). **30** : 215.
8. Measurements and weight of a Malay Tapir. **31** : 522.
9. The Dugong or Sea-cow (*Halicore dugong*). **33** : 84.
10. On the occurrence of tigers on the islands of Bombay and Salsette. **33** : 973.
11. Tiger or Panther? Mr. Limouzin's specimen. **34** : 547.
12. The Wild Animals of the Indian Empire. Part I. Introduction, Distribution of mammals, and Ungulates or Hoofed animals (*part*). **36**, Suppl., pp. 1-39. Part II. Ungulates or Hoofed animals (*contd.*). **36**, Suppl., pp. 59-96. Part III. Carnivora or Beasts of prey. **37**, Suppl., pp. 112-161.
13. Description of a Blue Bear (*Ursus arctos pruinosus*) from Tibet. **38** : 610.
14. Black Tigers. **39** : 381.
15. The Striped Hyaena as a Man-eater. **39** : 388.
16. Panther with abnormal feet. **40** : 321.

17. Additional notes on the Asiatic Two-horned Rhinoceros. **40** : 618.

18. Number of tigers shot in reserved forest in India and Burma during the year 1937-38. **41** : 881.

19. Breeding habits of Swamp Deer (*Rucervus duvaucelli*) in Assam. **45** : 415.

BIRDS

20. The Arabian Ostrich. **27** : 602.

21. Notes on two young Indian Hornbills. **28** : 550.

22. The occurrence of the Whiteheaded Black Bulbul (*Hypsipetes leucocephalus*) within Indian limits. **29** : 559.

23. On the occurrence of Pallas's Sandgrouse within Indian limits. **31** : 522.

24. The occurrence of the Giant Heron (*Ardea goliath*) in the Khulna District, Bengal. **31** : 523.

25. Brahminy Kite (*Haliastur indus indus*) swimming. **31** : 526.

26. Occurrence of the Christmas Island Frigate-Bird (*Fregata andrewsi*) on the West Coast of India. **33** : 445.

27. The migration of the White Stork (*Ciconia ciconia*). **35** : 459.

28. Double nests of the Weaver Bird (*Ploceus philippinus*). **35** : 681.

29. The Lesser Florican (*Sypheotides indica*) in the Konkan. **38** : 191.

30. The Long-tailed Duck (*Clangula hyemalis* Linn.) in Sind. **38** : 831.

31. The Snipebilled Godwit [*Limnodromus taczanowskii* (Verr.)] in Orissa. **40** : 332.

32. The Indian Black Eagle (*Ictinaetus malayensis perniger* Hodgs.) in Salsette. **41** : 899.

33. The occurrence of the Yellowbilled Flowerpecker (*Pachyglossa melanoxantha* Hodgs.) at Almora, U.P. **42** : 187.

REPTILES

34. Notes on some interesting snakes recently presented to this Society. **26** : 683.

35. Occurrence of Theobald's Kukri Snake (*Simotes theobaldi*) in Assam. **27** : 175.

36. Food of the Fat-tailed Lizard (*Eublepharis macularis*). **28** : 811.

37. Snakes of Bombay Island and Salsette. **30** : 151.

38. Large brood of eggs of the Checkered Water Snake (*Nerodia piscator*). **32** : 225.

39. Note on a Formosan Viper (*Trimeresurus macrosquamatus*) from the NE. Frontier. **33** : 998.

40. The Social Life of Snakes. **36** : 469.

41. Occurrence of *Dipsadomorphus multimaculata* in Assam. **38** : 201.

MISCELLANEOUS

42. On some unusual contributions to the Society's Museum. **27** : 966.

43. Notes on a visit to certain museums in Great Britain. **29** : 456.

44. Principles and extent of the educational service rendered to the schools by museums in America. **32** : 169.

45. Modern museum methods—Part I, **32** : 532 ; Part II, **32** : 762 ; Part III, **33** : 149.

46. The Social Life of Ants. **34** : 269.

47. Behaviour of the Red Tree Ant (*Œcophylla smaragdina*). **36** : 280.

48. The Fish Supply of the West Coast of India—Part I, **34** : 973 ; Part II, **35** : 77. (Jointly with Spence, Sir Reginald).

49. On a large Sawfish (*Prestis perrotteti* Mull. & Henle). **41** : 435.

50. The Whale-Shark (*Rhineodon typus* Smith) in Indian coastal waters, with notes on its wanderings in other areas. **42** : 255.

Reviews

1. BORN FREE : A LIONESS OF TWO WORLDS. By Joy Adamson. Pp. 156 (24×17 cm.). 9 coloured and 104 black and white photographs and 1 map. London, 1960. Collins & Harvill Press. Price 25*s*.

The story of a pet—and what a pet ! A lioness, reared with the liberty allowed to a poodle or a peke. Neither fully tame nor fully wild, reared by human fosterparents on a game reserve in Kenya, Elsa presents a fascinating study. Joy Adamson, in her account of Elsa's growth to maturity and subsequent release, provides answers—frequently surprising ones—to all these questions : what are her reactions to her fosterparents, to her own kind and other animals, to life on her own ? Astonishing as it is, the account gives no impression of fabrication or exaggeration.

It is as sincere as it is straightforward. Lucid, direct, yet charming, the style of writing is simple. Which contributes to its width of appeal—to the natural historian, to the scientist, and to animal lovers of all ages.

The highlight of the book is the series of photographs, more fascinating, more convincing, and more astounding than mere words could ever be.

I.R.

2. COMMON MALAYAN BIRDS. By M. W. F. Tweedie. Pp. 69 (21.50×15 cm.). 20 coloured plates ; 7 figures in text by A. Fraser-Brunner. London, 1960. Longmans. Malayan Nature Handbooks. Price 12*s*. 6*d*. net.

This is a most attractive and handy little booklet. It is admirably designed for the beginner in bird study, as well as for the visiting ornithologist, and tells them in brief all they will wish to know about the hundred or so of the commoner birds likely to be encountered in Malayan towns and in the inhabited countryside ; how to recognize them, and something about their habits, nesting, calls, etc. A short introduction touches upon general topics, such as migration, the use of scientific names, and so on. Eighty species are illustrated in colour, in some cases showing both male and female, and there are 7 useful black and white sketches in the text besides.

This happy combination of author and artist, and the excellence of the printing, both coloured plates and text, is something of which every one concerned in the publication can be justly proud. If the other volumes of the Malayan Nature Handbooks are going to be as good as this, the series will indeed be an enviable one. It should go a long way to awakening that interest in Nature among the young which is so sadly lacking in most eastern countries.

S.A.

3. BULLETIN OF ENTOMOLOGY, No. 1. Pp. 1-41 (24× 17 cm.). Madras, 1960. The Department of Zoology, Loyola College.

We already have an entomological journal—the *Indian Journal of Entomology*. In addition papers on entomology appear in many other journals of a more general nature, including the *Journal of the Bombay Natural History Society*. The appearance of another entomological journal is therefore an indication that the output of papers on the subject has now increased to a point when existing journals cannot cope with them.

The first number has some distinguished contributors. Dr. M. L. Roonwal and Dr. B. P. Uvarov have both written appreciations of the work of Dr. Y. Ramachandra Rao, to whom this first issue has been dedicated. Dr. Rao published his first paper in 1910, and has continued publishing steadily to the present time. His outstanding contributions to locust research are known to every student of entomology. Dr. W. D. Hincks of the Manchester Museum has sent in a description of a new species of *Diplatys*, a primitive and particularly interesting Dermapteran. He remarks on how little is known about the life-history and ecology of the genus. Unfortunately this is true of almost any group one could mention, apart from a few of economic importance. Of the other eight articles in this issue four are on taxonomy, three on bionomics, one on control, and one on the coagulation of haemolymph in a cockroach.

One hopes that the editors will keep the standard of future issues high. It is a great temptation for authors to use a new publication for articles which they do not consider good enough for established journals.

R.R.

4. BUTTERFLIES OF FORMOSA IN COLOUR. By Takashi Shirozu. Pp. 481 (25.5×18 cm.). Seventy-six plates in colour. 163 distribution maps and 316 other text-figures. Osaka, 1960. Hoikusha. Price $15.

This fascinating book is the product of twenty years of study by the author, Dr. T. Shirozu. Covering as it does a large number of species which are to be found in India, the book is of great interest to biologists and collectors in this country and, inspite of the text being in Japanese, they will derive help from the book by reason of its use of scientific names printed in the Roman character, its beautiful coloured illustrations, and its numerous maps showing the distribution of the species described. The illustrations are numbered in Arabic numerals corresponding to the numbering of the accompanying descriptions. In a separate synonymic list are set out in Roman character the butterflies described in the text. There is also an index in Roman character of the generic, specific, and racial names. It is therefore very simple to find the description, illustration, and distribution map of any butterfly that the reader happens to be interested in. Reference is equally simple for the reader who makes the illustrations his basis for identifying butterflies. Some idea of the profuseness with which the book is illustrated can be gathered from the fact that there are 997 coloured pictures of the 366 butterflies dealt with. Both sexes are illustrated wherever necessary. There are, besides, numerous large-scale drawings, clear and carefully executed, of the genital organs accompanied by detailed explanations in the text ; of course, except for the specialist who already knows something of the subject, these are of use only to a reader acquainted with Japanese. The author and the publisher are to be congratulated on the superb quality of the coloured illustrations, which reproduce the natural colour and even the texture with remarkable exactness.

T. Ikawa

5. COMMON MALAYAN BUTTERFLIES. By R. Morrell. Illustrated by A. H. Burvill. Pp. 64 (21.5×14.5 cm.). 20 colour plates. 6 figures in black and white. London, 1960. Longmans. Malayan Nature Handbooks. Price 12*s*. 6*d*. net.

This beautifully produced handbook is designed as an introduction to Malayan butterflies for beginners and newcomers. There is no key, but almost every butterfly dealt with is illustrated and the quality of the illustrations makes detailed description unnecessary. In 58 pages of text the author has included notes on breeding habits, when known, and other points of interest for over a hundred species. Among the most interesting are the Brownies (*Miletus* spp.), colonies of which haunt particular trees and bushes for years. The caterpillars of one species are known to feed on aphids, and the author suggests that the colonies of butterflies form round colonies of aphids, *Hypolimnas bolina bolina*, the Great Egg-Fly, a species common in India, is an interesting example of mimicry. The male is a striking insect, black with bold white-centred spots, while the females mimic *Danaus chrysippus*. In the nineteenth century there was a race *incommoda*, in which the females were black with sub-marginal white spots, not resembling *D. chrysippus*. By the end of the century the species became rare and finally extinct. After thirty years the species reappeared and re-established itself, but this time the females are mainly pale-brown mimics of *D. chrysippus*, although black females resembling the older form are also taken. It is noteworthy that in India the *H. bolina* female mimics *Euploea core*, the Common Indian Crow, and it is the *H. misippus* female that is a mimic of *D. chrysippus*.

Instructions to would-be collectors include advice on how to keep one's collection free from mould and insect damage, very necessary advice in a hot, humid climate.

R.R.

6. DRAGONFLIES. By Philip S. Corbet, Cynthia Longfield, and N. W. Moore. Pp. 260 (21.5×15 cm.). 53 colour plates, 16 photographs in black and white, 200 maps and diagrams. Key to larvae by A. E. Gardner. London, 1960. Collins. The New Naturalist. Price 42*s*.

The New Naturalist series has long since exploded two popular myths : one that the scientific expert is an erudite, inarticulate eccentric, totally incapable of conveying his enthusiasms, and the other that natural history is an inexact descriptive science. True to the tradition of the series, DRAGONFLIES is guaranteed to make an enthusiastic odonatist of any reader, and the beautiful colour plates will convince anyone, who did not know it already, that dragonflies are among the most beautiful of insects. They are also a very ancient group, with a fossil ancestry which goes back to the Carboniferous period. These early dragonflies were recognizably like their present-day descendants, but giants by comparison with them. One species, *Meganeura monyi*, had a wing span of twenty-seven inches. They must have occupied an ecological niche taken up by birds and bats today.

In the tropics dragonflies fly, and breed, right through the year. In the temperate zones, however, winter brings the flying season to an end, and dragonflies have developed methods by which they survive winter temperatures as eggs or larvae, and emerge as adults only when more favourable conditions return. Dragonfly life-histories in the temperate zones fall into three categories, each employing a different type of seasonal regulation. In the first group, the 'univoltine summer species', the eggs are the resistant, diapause, or resting stage. The larvae, which are susceptible to low temperatures, only hatch in spring, complete their development in two to five months, and emerge as adults in summer. They lay diapause eggs before winter, thus completing the cycle. The second group, 'semivoltine summer species', overwinter as larvae. Development continues during winter, but full-grown larvae cannot emerge as adults until the temperature rises above a threshold value. This results in the accumulation of full-grown larvae during winter, which emerge as adults as soon as summer temperatures reach the required level. The third and most specialised group are the 'spring species'. Here the fully grown larva undergoes diapause, and as soon as spring temperatures become suitable there is a mass emergence of adults. These lay eggs, larvae from which will survive the next winter. However, larvae which develop more quickly than their fellows and complete their growth before the beginning of June emerge immediately, the same year as they were hatched. Whether a larva will emerge at once, or go into diapause and emerge next spring, is determined in a very precise way. Larvae respond to critical differences in day length, and after the beginning of June, when the daily increase in day length falls below two minutes, they react by going into diapause. Dr. Corbet suggests that the type of life-cycle found in the tropics is the primitive one, and those in the temperate zones represent successively more efficient ways of colonising colder latitudes. This opens up fascinating fields for speculation. Other insects in the temperate zones show life-cycles superficially similar to that of some dragonflies, for example the biting midge *Culicoides impunctatus*. An emergence peak in early summer is followed by another a little later on. Will further investigation reveal similar mechanisms in other groups besides dragonflies?

A mass emergence of dragonflies must be impressive. It usually takes place at night. Overcrowding causes heavy mortality, for larvae crawl on top of each other, preventing those underneath from emerging. Birds kill off many of the newly emerged adults in the morning. The remainder make their maiden flight at dawn and, for the first few days of adult life, fly away from water. This response ensures that dispersal takes place. This is important because dragonflies, like birds, show territorial behaviour. Dr. N. W. Moore describes an experiment in which he released dragonflies at intervals over an artificial pond, and returned to count numbers. The number remained more or less constant over the water, the newcomers apparently being driven away.

One cannot end a review of this book without mentioning the excellent appendixes, of which the editors are justly proud. They cover every kind of information the new odonatist could possibly need, including a note to the effect that radioactive tracers *cannot* be used to tag dragonfly larvae since they are cannibalistic. R.R.

7. COMPARATIVE BREEDING BEHAVIOUR OF FOUR SPECIES OF NORTH AMERICAN HERONS. By Andrew J. Meyerriecks. Pp. 158. 15 plates and many figures. Cambridge, Massachusetts, 1960. Nuttal Ornithological Club.

In the last decade the ornithologist has been treated to a spectacular increase in the literature of his science particularly that concerned with bird behaviour. This is largely the harvest of seeds sown well before the last war by Konrad Lorenz in Germany and developed by Nikko Tinbergen, at first in Holland and later in Oxford. Comparative studies have had a leading role to play and recently a spate of works on many families, Gulls, Finches, Estrildines, and Weavers have been appearing, mostly in the periodical literature. To the European 'ethologists' it is thus gratifying to find that their observational approaches have now crossed the Atlantic and are bearing fruit in the U.S.A.

Dr. Meyerriecks's study is the second of a series of publications sponsored by the Nuttal Ornithological Club, of which Professor Ernst Mayr is the President. The intention of the series is to get into print important studies considered too large for the periodicals and not yet suitable for publication as books. One of the problems of behaviour work is the great detail of description required and this is always bulky when it comes to presentation. The club is thus performing an invaluable service to all behaviour students wishing to keep abreast of new knowledge in a rapidly expanding field.

The work consists of a detailed description of the behaviour of the Green Heron, *Butorides virescens*. Maintenance activities, locomotion, feeding, care of the body surface, escape responses, migration, agonistic and courtship behaviour are all treated in turn and the data compared with three other species, *Ardea herodias*, *Dichromanassa rufescens*, and *Leucophoyx thula*, which however have not been studied in such detail. The writing is fluid, eminently readable, and excellent photographs and figures assist the reader. The use of complex 'ethograms' for the presentation of raw data is however a pity. The number of repeat observations is too small, sometimes only a single behaviour sequence being represented, to merit illustration in large schemata. The 'ethograms' given would be better compressed into a line of text. Schemata of this, and indeed any, type are only justified if they represent a useful generalisation from a mass of observational data which is helpful to the reader. The provision of summaries would also be a help, for in such works the reader wishes to skim to certain points of interest and then refer to the necessary detail, rather than wade in detail to find the interesting points.

In the final discussion one misses consideration of the survival value of the different behaviour patterns described and their functional role in species ecology. One would like to know for example what differences in feeding niches go with the exceptionally interesting variety of feeding patterns, especially those shown by *rufescens*. The family is said to be particularly interesting on account of the differing degrees of sociality, from solitary feeding and breeding to gregarious colonial life, shown by the different species, but little attention is given to the actual spatial organisation of the populations in the environment and their relations to the exploitation of food. Nor is the degree and type of protection from predators afforded by the colony sites discussed. Adaptations in these respects may well play a major role in influencing other behaviour patterns, such as those occurring in displays.

This is however to expect too much perhaps. Excited by Dr. Meyerriecks's excellent data and capacity to interest, the reader inevitably starts asking questions that evidently lie beyond the scope of the present descriptive account. The excellent production, hard covers and cloth, perhaps lulls one into thinking one has a book in one's hands when the work is in fact a large paper. We must trust that Dr. Meyerriecks will be able to extend his work to other heron species and produce for us a monograph on the behaviour of these interesting birds.

J.H.C.

8. THE LONELY TIGER. By Hugh Allen. Pp. 191 (21.5× 14 cm.). London, 1960. Faber and Faber. Price 18*s*. net.

An interesting preface tells how the author and his sister, torn from their moorings by the war, decided to settle in India. Drawn to the forests of Madhya Pradesh, where he had hunted in his spells of war-time leave, he bought a large estate in one of the wildest parts of the Province. Largely owing to marauding wild animals, the agricultural venture did not meet with the expected success, but it raised, instead, a successful crop of shikar stories. Many of them have already appeared in well-known magazines, both in Britain and in the United States, and with adaptations have been included in this book. There are fourteen short self-contained stories but, as all the episodes recounted take place within a few miles of the author's adopted home, the book acquires a sort of unity and, half-way through, the reader gains the familiarity with the country and terrain so essential for even a vicarious enjoyment of shikar.

The reader who loves an engrossing tale will be fascinated and thrilled by the stories and, once started, will find it difficult to lay the book down. A hardened minority, however, who have some experience of the Indian jungle, may be nagged by a small questioning voice asking : 'Are the stories probable ?'. The usual shikar-story theme—going after the animal and outwitting it or being outwitted oneself—is, in this book, invariably enlivened and enriched by a variety of subsidiary incidents. Thus, a Russell's Viper intrudes upon the privacy of a melée between the author and a wild boar in its death throes. Again, just as a hungry impatient tiger is approaching the kill, with a 'growling grunt of pleasure', 'a high pitched shriek suddenly screams out of the night' to thicken the plot and the reader's blood. The probability of fish and wild life stories will always be open to question and, the better the story, the louder the questioning voice. However, I recommend the book even to the questioning sort of reader, for it is exceptionally well written.

The author knows the jungle and its animals. What is better, he feels the jungle and its ways, and has the rare capacity of conveying his sensations to his reader—the feel of being alone in the dark, the mounting tension of stalking or waiting for a dangerous animal, the sudden fear and the slow fatigue. A natural talent for telling a story appears to have been improved and polished till considerable literary ability is evident in the outstandingly good ones. Flexibility in style and the use of words to match the mood and action bring the stories to life. For instance, consider this lyric passage : 'The black clouds were now scudding away in the wake of the grumbling storm. As they went they unveiled a star-studded sky, set with a silver moon.' Contrast it with this savage description : '....the first bullet slams him to the grass with his legs kicking in the air. A moment later he is a snarling blur of threshing yellow fury as he tries to rise.'

Some of the stories read in isolation may give the impression that all is well with India's wild life, especially in isolated places like the author's adopted home, Mandikhera. This impression is most effectively corrected by the story, 'The Lonely Tiger', which gives the book its title. It vividly tells the sad tale of our beautiful fauna being wiped out from even the best of our jungles. Indiscriminately licensed muzzle loaders, booming through summer nights maim and murder every animal that comes to water. The revolting jeep-shikari blazes buckshot at every eye that shines in his blinding headlights. And above all, the apathy of the administration to enforce the law has brought desolation to India's forests. Better than volumes of official reports this story reveals the bitter tragedy of our age-old faunal heritage, which is a trust for the future, being squandered with the reckless haste of a criminal bankrupt.

Finally, I am prompted to comment on Indian shikar literature in general. Post-war books on the subject have produced a spate of dangerous tigers and panthers, mostly man-eaters ; and this, during a period that has seen a catastrophic decline in the numbers of our wild animals. The reading public's appetite for man-eaters seems to grow by what it feeds upon, and I feel sure that the author's outstanding literary ability will induce his publishers to ask for more man-eaters. Unfortunately, a time is fast approaching when any sort of shootable animal will be difficult to come across in this country. I humbly suggest that the only way open for a writer on wild life to utilize his talent is to frankly write his book in the form of a shikar romance and cast his story in the happier days of long ago.

D. J. P.

Miscellaneous Notes

1. JUNGLE DOGS KILL SAMBAR DOE

At 8.15 one morning, when I was fishing on the Badra River in Mysore State accompanied by a moplah acting as 'gillie', we saw at about 200 yards downstream a full-grown sambar doe drinking on the opposite bank of the river. After drinking a short while she retreated out of view into the jungle. A quarter of an hour later our attention was attracted by a commotion from that direction. My first impression was that a tigress with cubs was running along the far bed of the river half hidden by grass etc., but I soon saw it was the sambar doe with jungle dogs chasing her and making that queer hysterical yapping-cackling noise they make when close to their quarry. Almost at once she turned into the water and made slowly downstream at a halting walk for some 50 yards and about 15 yards from the bank. When she was about chest deep in the water, which was flowing at a moderate pace, one dog got in front of her and another on top of a rock between her and the bank as if to see that she did not make for land. The sambar then made what I like to think was a 'bell' of defiance and, whilst she was stationary, the dog in the water made a frontal attack. I was too far off to see what occurred in detail, but I saw the sambar's head and the dog disappear completely underwater. When her head reappeared she put it right up and gave a bellow of pain. After a short interval the dog, still in front, came in to the attack and again her head and the dog disappeared underwater and, when her head came out, the bellow of pain was repeated. The sambar then turned towards the bank and, after a slow halting step or two, bumped into a rock which was plainly visible. From this I conjecture that the dog had punctured her eyes and blinded her. I realised that the end was near, so started to walk down to get opposite the tragedy. By the time I arrived, she was dead and two dogs were attempting to drag her out of the water. As the bank was about a foot above the level of the water, they were unable to do so and only her head was out of the water on dry ground. I then left to do more fishing. On my return, I could see that the dogs, now gone, had only been able to clean up the head, which showed a white skull and nothing more. I am not sure how many dogs there were, but certainly not more than three (one of them lame), and definitely only one tackled her in the water.

The river was too deep for us to cross over and drive the dogs off, and our yells and abuse shouted in our best Kannada (Kanarese) were of no avail! Eventually, some locals were informed and took the carcass.

The reason I mistook the sambar for a tigress in the first instance was because she was running very low in a crouched position, either because she was blown or because a dog that I could not see was hanging on to her.

HOSKHAN ESTATE,
MALANDUR P.O.,
CHIKMAGALUR DISTRICT,
September 30, 1960.

G. V. R. FREND

2. HOW MANY YOUNG DOES A CHITAL HAVE?

In THE BOOK OF INDIAN ANIMALS the late Mr. Prater wrote: 'chital are prolific breeders; one to three fawns are born at a time—two being the commoner number'. This statement was tested on a reference by Dr. William Graf, Professor of Zoology, San Jose State College, San Jose, California, U.S.A., whose experience with chital in Hawaii is that there is no record of twin fawns, either in captivity or observed in the wild, and the examination of many pregnant does has not yielded a multiple foetus. The standard writers, like Jerdon, Sterndale, and Blanford, do not make specific mention of the number of young. Enquiries from persons likely to know have given the following results:

1. R. S. Dharmakumarsinhji of Bhavnagar, who has experience of chital in semi-domesticated conditions, has not seen more than one fawn at a time.

2. The Wild Life Club, Forest Research Institute and Colleges, New Forest, Dehra Dun, started a deer park in May 1958 with four chital. Since then 7 fawns have been born. There has been no case of more than one fawn at a time.

3. Mr. Krishna Talcherkar remembers seeing one foetus in a doe shot in Indore State.

4. The Municipal Gardens in Bombay have had several births in their garden every year. An examination of their records for 30 years (which include 97 since 1946) reveals no instance of more than one young at a time.

5. Mr. Hugh Allen of Mendikhera Estate, P. O. Matkuli, Piparia (Madhya Pradesh) reports that within the last ten years 21 wounded hinds, which had wandered into the estate and had to be shot, were pregnant; of them none had more than one foetus. Also, neither he nor Col. S. A. H. Granville of Pachmarhi, in their considerable experience, has ever observed more than one fawn with a hind.

Mr. Prater's statement is probably based on the authority of Dunbar Brander who wrote in THE WILD ANIMALS OF CENTRAL INDIA: 'one to three are born at a time, but two is the commoner number'.

In the light of these facts, it may be necessary to make an amendment in THE BOOK OF INDIAN ANIMALS.

91, WALKESHWAR ROAD,
BOMBAY 6,
November 7, 1960.

EDITORS

3. INDIAN WILD BOAR (*SUS SCROFA CRISTATUS* WAGNER) FEEDING ON *BOERHAVIA DIFFUSA* LINN.

During the monsoon rains a prolific weed grows rampant in open country and scrub in the Saurashtra peninsula and in other parts of western India including the Deccan. This weed was kindly identified as *Boerhavia diffusa* by Shri K. Satyanarayana, M.SC., of the Samaldas College, Bhavnagar.

While observing the feeding habits of wild boar over many years, I have noticed them rooting at particular spots and after a brief effort eat something and move on, and then again stop to do the same. In this way open grass plots in stony ground would be neatly ploughed in bits. Subsequent examination of such plots revealed that the wild boar had removed the damp soil to the depth of 4″ to 6″ at the base of the plant and with the aid of its snout removed the earth and laid bare the tap root which in most cases had been completely eaten. At every rooting, it was this plant that had been attacked and no other; and the stem, leaves, and flowers were left untouched on the surface. The preference of the wild boar for the succulent roots of *Boerhavia diffusa* was very noticeable in open stony ground covered with soil and grass of the 'moram' type. This selective feeding of wild boar was seen at various places as far as 100 miles (*c.* 160 km.) apart. The vernacular names of the plant are Ghetuli, Punarnava, Sant, Şathodi, Thikri, and Vakhakhaparo. In English, it is known as Hog Weed, Pig Weed, and Spreading Hog Weed. It is of much interest to find that the name corresponds with the feeding habit of the wild boar, but it is unlikely that the weed is named on account of the wild pig feeding on it. The weed often grows in abundance and close together on the surface as it spreads, though the roots are fairly far apart. The wild boar do not exterminate the plant but often return to the same ground for feeding on it. Is it possible that wild boar feed on the root for a specific urge or for taste or as a natural food?

Boerhavia diffusa appears to be a useful medicinal plant and both the herb and the roots are made use of for different ailments. In what way the root benefits the wild boar is not known, but as a medicine to man, the herb has a wide use, e.g. infusion, diuretic, laxative, stomachic diaphoretic, anthelmintic, and for diseases such as Bright's disease, dropsy, œdema, anæmia, jaundice, cough, pleurisy, asthma, gonorrhoea, and for inflammation of the spleen, liver, heart, eye, and for ulcers. A poultice is also used for extracting guinea worm. It is also said to be effective for snake bite. The white flower form of this species is also found and is the more valuable for medicinal purposes.

DIL BAHAR,
BHAVNAGAR, R. S. DHARMAKUMARSINHJI
August 15, 1960.

4. FURTHER WILD LIFE NOTES FROM MADHYA PRADESH—A REJOINDER

In the August 1959 number Mr. Humayun Abdulali contributed a miscellaneous note about methods of shooting and conservation of wild life in Madhya Pradesh (*J. Bombay nat. Hist. Soc.* **56**: 321-323). Mr. Vidya Charan Shukla, M.P., in a letter to the Society, raised strong objections to certain statements therein and some correspondence was exchanged with Mr. Abdulali thereafter. Mr. Shukla wrote to the Editors requesting that his letter be published and it was thought that certain points from Mr. Abdulali's replies should also be reproduced. As, however, personal elements had crept into the correspondence, the Editors decided to publish a comprehensive editorial note embodying as objectively as possible both points of view. Pending publication, however, Mr. Abdulali is now a Joint Editor of the Journal, and the Editors considered that in fairness to Mr. Shukla his objections should be reproduced in his own words without any comments thereon omitting only passages in the nature of personal criticism. Mr. Shukla writes:

'In miscellaneous note No. 6 of Vol. **56**, No. 2 of the *Journal*, Shri Humayun Abdulali has made certain statements which are grossly misleading and erroneous. As a person closely connected with hunting and matters pertaining to wild life, I consider it my duty to correct such untrue reports.

'I am the "Managing Director of one of the leading shikar agencies in the country" who drove Shri Abdulali to Supkhar in Balaghat district to join the party of Americans who had invited him.

'We discussed wild-life and hunting, it being the topic of our mutual interest, and naturally came to the subject of illicit shooting. Shri Abdulali complained of shooting at night from jeeps with particular reference to our staff. I explained him that when a tiger or a panther is wily and the hunters fail to shoot it in a sit-up or beat and happen across it on a night-drive, when out looking for vermin, shooting of which is allowed at nights from jeep, they step down with a spot-light from the jeep, to hunt it and the jeep is driven away.

'There was no mention of spot-lights being connected to the battery of the jeep and the connecting wire being rolled all along the road or the jeep being backed the prescribed distance of 100 yards in the dark. The spot-lights used at such times have self-contained batteries and the jeep is reversed or turned according to the space available.

'The entire purpose behind restricting shooting at night from jeeps is to give a sporting chance to the animals and the method used by our hunters on such occasions affords more chances and advantages to the animals than they get in beats or sit-ups which are universally accepted methods of sport.

'From the way, the shooting of bear and wild boar at night has been described in the note, it will lead one to think that it was illegal. Both these animals are classed as 'vermin' and their shooting is permitted at night from jeeps. Apart from the legal aspects of the night shooting of these animals, their shooting whenever one gets a chance is morally just and warranted. In the forests, 95% of mauling instances are by bears who without any provocation attack the villagers when they go to jungles to seek their livelihood. Wild pig is the greatest destroyer of crops. If the wild-life preservation is considered rationally on the basis of practical experiences and circumstances as they exist, the number of such vermins will never be allowed to grow uncontrolled under the protection of game laws to the extent of being detrimental to "man and food".

'Another thing Shri Abdulali has put in my mouth during my conversation with him. From the way he has reported, it implies that we had been breaking laws in the past. What I told him was that in the earlier years of our business, our hunters did unwittingly shoot a few animals in violation of game laws; but the redeeming factor was that the matter was immediately brought to the notice of the forest authorities and due punishment was met for the same. I had taken the trouble to impress that such instances were due to inexperience of our staff and now we have gained more experience, the cases of game law violation are rare.

'The note poses a question whether it is a wise policy to "sell" the remains of our wild-life in the temptation of earning a few more dollars. A critical study of the problem of wild-life preservation at first hand will show that the real menace to our wild-life is from poaching by our own people over which neither any control is being exercised nor is being desired; and not from hunting by foreigners who without exception shoot only on valid permits and strictly restricted number of animals allowed to them. A complete watch on their shooting is always kept.

'The wild-life preservation will never assume the importance it deserves unless it shows immediate economic benefits and shikar-tourism from abroad gives a certain economic value to our well-stocked forests. Mr. Abdulali himself admits the well-stocking of our forests when he says that the party, whose guest he was, shot its quota in 10 days; but did they in any way exceed the game limit allowed to them? How are they or other foreign hunters guilty of destroying wild-life if they shoot within the limits allowed to them which is set by the Forest Department after a survey of the wild-life population? No country in the world has stopped sport-hunting to protect its common run of wild-life for the obvious reason that essentially the hunters who particularly understand the wild-life preservation problem have its interest in their hearts.'

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD, EDITORS
BOMBAY 6,
November 1, 1960.

5. COLOUR ABERRATION IN THE WHITECHEEKED BULBUL [*PYCNONOTUS LEUCOGENYS LEUCOTIS* (GOULD)]

During the field work in the Bombay Natural History Society's Bird Migration Study Project on Kuar Bet (Great Rann of Kutch) in March 1960, two aberrant examples of the Whitecheeked Bulbul (*Pycnonotus leucogenys leucotis*) were taken in the nets. Both were young females. The over-all effect of their plumage is a uniform pale sandy, or isabelline. They differ from normal birds—abundant on the island—chiefly in the following particulars: Forehead, crown, nape, and hindneck sandy brown, concolorous with the back; in one the feathers of the crown are edged darker. Chin and throat like head. Ear-coverts silky off-white. Underparts from lower throat to vent paler sandy brown than back. Tail somewhat darker than back, all feathers tipped with whitish and largely cross-rayed.

The skins were sent to Prof. Erwin Stresemann, Berlin, for opinion. He writes:

'Your two curious skins have just arrived. I consider them to be a "pallelogical" aberration of *Pycnonotus l. leucotis*. Both are still in juvenile plumage. They are deficient in black melanins (the so-called "eumelanin") while the brownish melanins ("phaeomelanin") seem rather unchanged, which is also true for the carotenoid colouring of the under tail-coverts. The barring (cross bars) developed not only on the tail feathers but also faintly to be seen on the primaries, may (or may not) indicate that these two specimens suffered periodic starvation in the nestling stage. I know of similar cases in *Acrocephalus, Sylvia,* etc. In former days one would have been glad to make these birds types of a brand new species. But, unfortunately, they do *not* deserve such an honour! Nevertheless, they are of considerable interest.'

The arid, semi-desert area of Kutch in western India seems to favour the development of this kind of heterochrosis which Prof. Stresemann calls pallelogical, as well as albinism—total or partial. Instances have been frequently recorded in back numbers of the *Journal*, involving not only birds but also insects and mammals. The aberrant bird species recorded include Bush Quail (*Perdicula asiatica* or *P. argoondah ?*), Common Babbler (*Turdoides caudatus*), Redvented Bulbul (*Pycnonotus cafer*), Comb Duck (*Sarkidiornis melanotos*), and Great Indian Bustard (*Choriotis nigriceps*).

33, PALI HILL,
BANDRA, BOMBAY 50,
October 29, 1960.

SÁLIM ALI

6. WHERE DO LEAF WARBLERS (*PHYLLOSCOPI*) SLEEP?

I noticed the other day how the *Phylloscopi* spent their nights when wintering in these parts. They seem to roost singly under the fronds of papaya trees (*Carica papaya*) for preference. I had observed one bird regularly settling for the night in this manner some years ago at Trivandrum. Now I have noticed the same thing happening here also. There is a papaya tree near my gate which one *Phylloscopus* (with a yellow supercilium and yellowish wing band, and calling *tsit-chew*) is visiting every evening to roost in. I believe it must be the same bird as it comes every evening just before sundown and makes its bed under the same leaf.

STATE MUSEUM AND ZOO,
TRICHUR, N. G. PILLAI
KERALA,
December 23, 1959.

[The *Phylloscopus* above could be either the Greenish Leaf Warbler (*P. trochiloides nitidus*) or the Largebilled (*P. magnirostris*), both of which broadly answer to the description. The former is the commoner of the two in the low country of Kerala.—EDS.]

7. A NEW RACE OF FINN'S BAYA, *PLOCEUS MEGARHYNCHUS* HUME

In 1954 (*J. Bombay nat. Hist. Soc.* **52** : 599-601) I compared a series of Finn's Bayas (*Ploceus megarhynchus* Hume, 1869) obtained in captivity and said to be from the Himalayan foothills in Kumaon in western Uttar Pradesh, with specimens collected in a wild state in the Bhutan Duars and in Assam. Though the differences appeared to be of subspecific value, I did not name them, as one group consisted entirely of cage birds whose origin could not be determined with certainty.

Last year Drs. Sálim Ali and J. H. Crook revisited the Rampur and Haldwani districts of Kumaon (U.P.) and discovered large numbers of *Ploceus megarhynchus* breeding in that area (*J. Bombay nat. Hist. Soc.* **56** : 457-483). The specimens which they brought back agreed with the cage birds, and a comparison with six more specimens collected by Koelz from Agia near Goalpara in Assam (very kindly lent by the Museum of Zoology, University of Michigan) prompts me to reiterate the differences between the typical form of the west and those obtained in the east:

WESTERN MALES COLLECTED BETWEEN 9TH MAY AND 20TH AUGUST (9 SPECIMENS)	EASTERN MALES COLLECTED BETWEEN 2ND MAY AND 8TH JUNE (6 SPECIMENS)
(*a*) The yellow forehead extends over 26-29 mm., averaging 27 mm.	(*a*) The yellow forehead extends over 18-26 mm., averaging 20 mm., in length,

This difference may have been accentuated to some extent by the method of preparation involving stretching or telescoping of the skin.

(*b*) The yellow on the head is richer than that on the breast and matches that of *Ploceus philippinus*. Two first year birds (?) have their heads brownish and washed with yellow as in females.	(*b*) The colour of the head is a purer yellow.
(*c*) All have bright yellow or traces of yellow on the rump to a varying extent. Some have exceptionally large patches extending from the lower back to the tips of the upper tail-coverts. In one wild bird there is a suggestion of this being continuous with the yellow of the head (BNHS 20172).	(*c*) One (with testes 10 mm.) has the upper tail-coverts yellow (Michigan Museum 147925 dated 8th June), but others including specimens marked 'Nesting' (2nd May) show very slight or no trace of yellow.
(*d*) The yellow on the under-parts extends from the chin to the vent and includes the thighs and the under tail-coverts. This is noticeable in the colour plate accompanying Finn's description of *P. rutledgii*, *Ibis*, 1903, p. 32. None in breeding plumage shows any white on the belly.	(*d*) In none does the yellow extend to the under tail-coverts, which are white. and in four the lower belly is also white.

WESTERN FEMALES COLLECTED ON 15TH JANUARY, 10TH JULY, 6TH AND 8TH AUGUST, 12TH SEPTEMBER AND 8TH OCTOBER (6 SPECIMENS)	EASTERN FEMALES COLLECTED ON 25TH MAY (2 SPECIMENS)
(*a*) All are yellow from chin to under tail-coverts though paler than in the male and of varying intensity.	(*a*) In the two females collected by O'Donel on the 25th May in one the yellow is restricted to the chin and upper breast, while in the other it goes down to the abdomen, but does not extend to the lower belly and the under tail-coverts. This was the bird available to Whistler and termed a 'particularly vigorous female of *Ploceus burmanicus*.

These differences, which in general were accepted by Drs. Sálim Ali and B. Biswas who have examined the material, are, I think, sufficient to warrant a separation, and I hereby name the BNHS specimen No. 6933 (male) collected by O'Donel in the Bhutan Duars on 25th May 1912 as the type of

Ploceus megarhynchus sálimalii subsp. nov.

in recognition of the interest Dr. Sálim Ali has always shown in this elusive species, which interest really induced me to examine the cage birds and enquire into their plumages.

Drs. Sálim Ali and J. H. Crook have drawn attention to the extraordinary nesting habits of the western subspecies, namely that it builds nests high up in trees with entrances at the side rather than hanging nests as do the other weaver birds in India. Stuart Baker in NIDIFICATION **3** : 4 says that O'Donel in his letters to him stated that he 'had discovered the colony in a vast area of grass more or less intermixed with scrub and the nests were untidy balls of grass strips far more like the nests of *Ploceus manyar* than those of *philippinus*, and that none of them had tubular entrances. The nests were larger than those of *manyar* and were fixed to the stems of the grass, generally several of these, loosely and carelessly put together with no lining. The colony consisted of at least 20 birds but seems to have been rather scattered.'

Several of the specimens collected by Koelz are marked 'Nesting' but it has not been possible to ascertain if the nests were in grass or in trees. O'Donel's note however seems to be fairly specific that the nests were attached to grass, and though there is no evidence that O'Donel found either eggs or young in the nests, he appears to have examined completed nests. Considering that the type referred to above is in what appears to be full breeding plumage, it is unlikely that he was referring to the doodling nests in grass mentioned by Drs. Sálim Ali and Crook. Also, having once found such nests he could hardly have overlooked the very conspicuous clusters in the trees. If this difference in nesting habits is confirmed it would be an exceedingly interesting variation in habits between geographical races.

Another interesting point which requires clarification is the significance of the prominent brown collar across the upper breast, completely visible only in one cage bird dated 20th August but traces of which are visible in all the males in yellow—apparently it disappears in off plumage. Dr. Sálim Ali failed to see any individuals with such complete collars and the data available suggest that this occurs either sporadically in a few individuals or is acquired after breeding. Traces of these spots and bands are visible in females of both groups.

The eastern male dated 31st March has a tiny patch of yellow on the forehead and another on the chin. The label is marked 'Testes 5 mm.'. A female dated 30th March is very similar, except that it has no yellow other than a very faint suggestion on the chin. These two are otherwise in off plumage, with no yellow, and very similar to each other.

Dr. Sálim Ali was informed that this species bred twice a year, in July and again in September.

Much work still remains to be done on the races of this very interesting species.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6,
October 27, 1960.

HUMAYUN ABDULALI

8. THE BLACKBACKED WOODPECKER, *CHRYSOCOLAPTES FESTIVUS* (BODDAERT), IN GANJAM, ORISSA

During the summer of 1947, a pair of Blackbacked Woodpeckers [*Chrysocolaptes festivus* (Boddaert)] aroused interest by their continual loud rattling laugh as they chased each other up the boles of tall trees standing on a flat streamside plain in dense moist deciduous forest in Coupe No. 1 Baliguda Reserve Forest, nearest village Durgapunga, 18 miles from Muniguda railway station on the Raipur-Vaisakhapatanam line. A search finally discovered their nest, situated 30 feet (*c.* 9 m.) above the ground in the trunk of a semi-decayed *Shorea robusta*, marked for felling, growing in shady forest of the same species of tree along the banks of a small stream. The young were allowed to fly—only two young emerged—before we felled the tree.

GUDUR (NELLORE),
S. INDIA,
October 31, 1960.

K. M. KIRKPATRICK

[The few nesting records from Kanara (Davidson), Nilgiris (Howard Campbell), and Travancore (Stewart) refer to one egg only, though in Ceylon (subsp. *tantus* Ripley) Wait says they lay one to three eggs.—EDS.]

9. THE IMPERIAL GREEN PIGEON, *MUSCADIVORA AENEA* (LINNAEUS), ON SALT-LICKS IN ORISSA

The forest country between Durgapunga in Baliguda, Ganjam, and Panjama, in northern Jeypore Samasthanam, Orissa, is a poor stag-headed Moist Deciduous Champion type 3/B, growing over a whitish chalky soil. Streams in the area carrying this mineral suspended in their waters are slightly saline; too much drinking direct from such streams causes the bowels to purge, and constant drinking results in fissure-tongue. However, animals visit stream banks to lick this mineral deposit and, watching over such licks, I have noticed that the Imperial Green Pigeon [*Muscadivora aenea* (Linnaeus)] is a constant visitor, flying down to the ground to pick the crumbs of soil thrown up by the scrapings of larger deer and Gaur. The only other Columbidae noticed on such licks is *Chalcophaps indica*, the Emeraldwinged Dove, though in this latter case I cannot say whether the birds were picking at the mineral or at the animal droppings scattered about for seeds and termites.

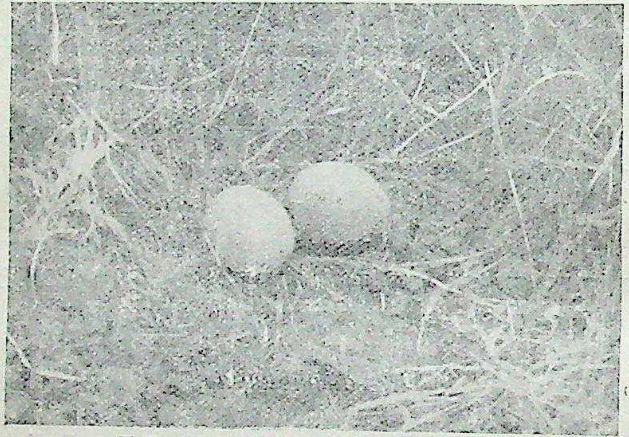
GUDUR (NELLORE),
S. INDIA, K. M. KIRKPATRICK
October 31, 1960.

10. ON THE EGGS OF THE GREAT INDIAN BUSTARD [*CHORIOTIS NIGRICEPS* (VIGORS)]

(*With a photograph*)

It has been repeatedly stated that the Great Indian Bustard [*Choriotis nigriceps* (Vigors)] lays only one egg. The largest collection of the eggs of this bustard was made by Khan Nizam-oo-din Khan; according to Stuart Baker, it was 'really wonderful' and contained many types. The next ornithologist who collected a large number of the eggs was Harrington Bulkley. Both these expert collectors strongly emphasize that the species lays only one egg. 'Harrington Bulkley once found two eggs actually together, within a few inches, but even these he believes to have been laid by two birds' (Baker, E. C. Stuart, 1935: 332). Earlier on the same page Stuart Baker writes: 'Only one egg is laid, and when two are found close together they are almost certainly the produce of two birds. Once the Khan found two eggs together but one was on one side of a tuft of lemon-grass and the second on the other side, while in two other cases two eggs were found just a yard or so apart.' Again, in 1921 in GAME BIRDS OF INDIA, BURMA, AND CEYLON **2** : 170, Stuart Baker writes: 'Khan Nizam-ud-din has taken more than a hundred of these eggs with his own hand, and he never found two eggs side by side. Where, as not unfrequently happens, two are within a yard or two of each other, he believes that they belong to different birds, and that this is a fact he has in one or two cases proved by snaring both females.'

In my long experience with bustards, which, as regards seeing the eggs, is not, however, anywhere near that of former collectors, I had never, until recently, found a nest with two eggs. Hence there seems to be no doubt that, ordinarily, one egg is laid and, when two eggs are found near each other, they are probably eggs laid by two separate hens.



Two eggs of Great Indian Bustard

And yet, it is not right to be dogmatic on this point. Stuart Baker (1921) writes on page 172: 'undoubtedly, the number normally laid is only one, and the exception to this rule is of the rarest. I have, however, in my collection one pair of eggs which are said to be from the same bird, but even here I must record the fact that they were found about a foot apart, in the same small beaten-down patch in a field of lemon grass. The eggs are of the rich brown variety, and are so exactly like one another in every detail that it seems probable that they are a pair.' No mention is given of the size of the eggs but it appears almost likely that the clutch was the outcome of a single female. The Yuvraj Saheb of Jasdan saw a nest, containing two eggs lying close to each other, and showed it to Sir Cyril Hancock, a former Resident of the Western India States, who was paying a visit to the area.

My recent experience confirms this. Last year, while closely studying the species, my shikari found a nest with two eggs (see photograph). In the grassland *vid* in which the nest was found another hen bustard was already brooding a single egg, not two hundred yards away. Subsequently, I flushed the hen off the nest in which the two eggs had been laid, and kept the bird under observation from a hide. In this case, the two eggs were next to each other, not even an inch apart and their size also indicated that they were a true pair. This is, therefore, I feel an authentic case where one hen had laid two eggs.

I took careful measurements of the pair and they were as follows: 71×53.5 mm. and 70×52 mm. It is interesting to find that one of these eggs is slightly smaller in width than the minimum width recorded, which is 53.5 mm. (Baker, 1935 : 333): In shape and colour the pair of eggs were almost alike, somewhat resembling those of the lesser florican. One egg was a pale sea-green; the other was slightly drab and had a few rusty markings. Both had very few, or hardly any, pimples.

Jerdon (1864 : 610) writes: 'The female lays one or two eggs . . .'. On what grounds he mentions two eggs is rather obscure. However, a conclusion can now be drawn that the Great Indian Bustard does lay two eggs but does so very rarely.

DIL BAHAR,
BHAVNAGAR, R. S. DHARMAKUMARSINHJI
August 9, 1960.

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11. ASSOCIATION BETWEEN DIFFERENT SPECIES OF TURNICIDAE

On Sunday, 9 October 1960, whilst on my way to the big swamp near Chintavaram on the Gudur-Yerur Road, I stopped in scrub-jungle to catch a young *Turnix dussumieri*, the Little Button-Quail, apparently the last of its brood, that legged it off the road behind the parent to take cover in weeds beneath a thorny shrub, from where we caught it by hand. The little mite took captivity well, settling down to consume, for its ping-pong-ball-size, an enormous quantity of termite larvae.

On Tuesday, 11 October 1960, a friend sent me a basket of eight *Turnix suscitator*, the Bustard-Quail, comprising seven females and a solitary male. The male was rescued from the kitchen-knife and put into a cage next to the baby *T. dussumieri*. The baby at once began to struggle frantically to get through the wires to join the larger bird until, nervous that it might damage itself, we put it into the same cage. It ran 'peep'-ing loudly to the *T. suscitator*, who accepted it beneath its breast without demur, and the two now live together as father and adopted son quite happily, the elder bird breaking the cells of the termite houses given them and allowing the younger to come forward and feed freely. At night, the baby *T. dussumieri* nestles beneath the embracing feathers of *T. suscitator* to sleep, and at no time has the elder bird attempted to drive the baby away.

This is interesting as quails are usually nasty-tempered little birds.

The other interesting feature is the quantity of termites and termite larvae that they consume, showing a marked preference for these to seeds and other small soft-bodied insects. Surely they must constitute an important controlling factor over these damaging insects?

GUDUR (NELLORE),
S. INDIA, K. M. KIRKPATRICK
October 13, 1960.

12. MARSH SANDPIPERS (*TRINGA STAGNATALIS*) COLLIDING AGAINST TELEPHONE WIRES

On the morning of 22 December 1958, when I was driving along the new jetty road to the port of Bhavnagar, a three-mile stretch of road passing through salt pans with telephone posts and wires along the side, I saw three birds out of a large flock of Marsh Sandpipers (*Tringa stagnatalis*), which flew across in front of me, drop suddenly like stones, as if shot in the air. Amazed, I stopped, got down from the car, and went over to the side where I found the ill-fated birds, one of which was still fluttering in its death throes. One by one I picked them up, and saw that two had their necks neatly cut and were bleeding from the throat and gape, and the third had both its wings cut. Immediately, I realised the cause of the accident, the telephone wires. On the following morning, driving past the same place, I found a dozen birds, all Marsh Sandpipers, lying on the side of the road freshly killed, and a Brahminy Kite gliding over the road and picking up a dead bird. I then carefully observed the to-and-fro feeding flights of the Marsh Sandpipers which passed close past the telephone wires and watched their sudden swerving up or down to avoid them. The real fact was that a flock of *T. stagnatalis* feeding on one side of the road in shallow saline water a few inches deep, served as a decoy, thus attracting other feeding flocks of the same species to join them. The in-coming flock would fly low across the road, often followed by another in quick succession, and in this process some birds collided against the wires and were killed. I have often driven along the same road and watched the feeding flights of other shore birds but have not found any dead by the roadside, although I once saw a winged flamingo and also a spoonbill.

DIL BAHAR,
BHAVANAGAR, R. S. DHARMAKUMARSINHJI
August 16, 1960.

[Telegraph wires in certain places take a heavy toll of birds, particularly those which move in flocks. At Bharatpur in Rajasthan, we were informed that during the cold weather, people patrolled the line of telegraph posts along the famous duck jheels to pick up one or more duck every day.—EDS.]

13. THE CHRISTMAS ISLAND FRIGATE-BIRD, *FREGATA ANDREWSI* MATHEWS, IN INDIAN WATERS—A CORRECTION

I recently had occasion to re-examine the frigate-bird in the Society's collection obtained by L. A. Lampard at Quilon, Kerala, and recorded as *Fregata andrewsi* Mathews in *J. Bombay nat. Hist. Soc.* (1929) **33**: 445. This was repeated by Whistler & Kinnear [*J. Bombay nat. Hist. Soc.* (1937) **39**: 450] and Sálim Ali (1953) in THE BIRDS OF TRAVANCORE AND COCHIN. The latter included therewith a young specimen obtained by Ferguson near Trivandrum and originally noted as *Fregata ariel.* The identity of the latter cannot now be checked upon, but the specimen in Bombay is completely black with the upper plumage glossed with green and the lesser wing-coverts brown. The primaries are moulting and several having dropped off, the two wings are of different sizes, the larger being only 524 mm. The tail is 410 mm., and the exposed culmen 96 mm. (gape 129 mm.), making it *Fregata minor*. This leaves no authentic record of *F. andrewsi* from Indian limits, and records from Ceylon have also been determined as in error for *F. minor* [Gibson-Hill, *Spolia Zeylanica* (1953) **27** : 95-96].

Fregata minor has been recorded independently from Bombay by Commodore R. M. T. Taylor, Mr. C. McCann, and Dr. Sálim Ali in June and early July [*J. Bombay nat. Hist. Soc.* (1953) **51** : 939], and referred to as the Lesser Frigate-bird. It may be worth mentioning that, in spite of the name *minor*, this is not the smallest frigate-bird and Alexander [THE BIRDS OF THE OCEAN (1955) p. 168], Whistler [Avifaunal Survey of Ceylon. *Spolia Zeylanica* (1944) **23** (3 & 4): 288] and Henry [GUIDE TO THE BIRDS OF CEYLON (1955): 367] all refer to it as the Great Frigate-bird, restricting the term Lesser or Small to *Fregata ariel*!

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6,
October 3, 1960.

HUMAYUN ABDULALI

14. OCCURRENCE OF THE LEAST FRIGATE-BIRD [*FREGATA ARIEL* (G.R. GRAY)] IN BOMBAY

In July 1960 a frigate-bird was shot with a .177 airgun by Mr. Kevin Miranda at Land's End, Bandra, near the sea-shore, and sent to St. Xavier's High School, where it is preserved. It was flying just above the water with a fish about 6 in. long in its beak. The bird is all black, the feathers of the head and upper parts have a metallic green sheen, and taper to points. The under parts are duller with two white patches on either side of the belly extending to the under wing-coverts.

The wing measures 520 mm., the tail 325 mm., and the bill from the feathers 82 mm. (96 mm. from gape).

The colour and measurements agree with those of a male Small Frigate-bird, *Fregata ariel* (G. R. Gray), and this would appear to be the first record of this species from India though it had been noted from the Maldives and Ceylon. In the *Journal* (1904) **16** : 13 Ferguson wrote of a young bird being taken at Perumathoray, about 10 miles from Trivandrum, but Sálim Ali (1953) in THE BIRDS OF TRAVANCORE AND COCHIN has referred to this as *Fregata andrewsi*. In the absence of the specimen and the fact that only two species were recognized in Ferguson's time, this record must now be written off as uncertain.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD, HUMAYUN ABDULALI
BOMBAY 6,
October 3, 1960.

15. A NOTE ON THE COMMON MONITOR, *VARANUS MONITOR* LINN.

Several reports on monitors have been published in the *Journal of the Bombay Natural History Society.* Without making any reference to or comment upon previous records, the writer wishes to record his own observations.

Breeding season, etc. The breeding season of the Common Monitor, *Varanus monitor* Linn., in Uttar Pradesh, as observed by the writer in Lucknow and Gorakhpur, extends from the middle of April to the end of July. The number of eggs laid by the females of this species varies from 8 to 19 (as was apparent from the collection of eggs on five occasions). The size of the eggs varied from 47×36 mm. to 55×44 mm., the average size of 50 eggs being 49×38 mm. The weight of the eggs varied from 9.3 gm. to 14.5 gm., the average weight of 25 eggs, sorted at random, being 11.4 gm.

On one occasion, the eggs were collected from beneath thick vegetation in a ruined and neglected building, about five miles (8 km.) from the Lucknow University. However, this seems to be unusual because this lizard normally digs a hole in the ground, deposits its eggs in the hole, and covers the eggs with the dug-up earth and other débris in such a way that it is difficult to spot them.

All efforts to get freshly hatched young ones from the eggs under laboratory conditions, for infection experiments, proved futile.

During the course of his investigations on the incidence of opalinid (Protozoa) infections in the preserved specimens of the various species of monitors in the collections of the Zoological Survey of India, the writer came across two female gravid specimens of *Varanus monitor* which were collected from Bikaner State (Rajasthan) on the 5th April 1957. The specimen Reg. No. 20739 measured 54.1 cm. in length, and the other, Reg. No. 20740, measured 35.2 cm. (both measurements are inclusive of the tails). The former specimen was found to contain 17 eggs, the latter 9 eggs, a result which accords with the assertion of Smith (THE BRITISH AMPHIBIANS AND REPTILES, 1954, p. 169) about British lizards that the number of the eggs produced at one time increases with the age and size of the female. The eggs were more or less fully mature; thus, it seems that the breeding season of *Varanus monitor* begins in Rajasthan sometime earlier than April.

Diet, habits, etc. As regards the diet of *Varanus monitor*, all sorts of seizable prey has been included in its menu. However, the writer from his observations on this lizard in the field, and from the examination of the gut-contents of a large number of specimens [as also of the gut-contents of several specimens of *V. flavescens* (Gray), *V. griseus* (Daudin), and *V. nebulosus* (Gray)], feels convinced that these mostly terrestrial monitors feed primarily on large insects (beetles, grasshoppers, roaches, etc.), and small lizards and snakes. Birds and their eggs, small rodents, and other animals are only occasionally preyed upon. They are, no doubt, fond of rats and mice, but in view of their diurnal habits the monitors do not frequently come across these rodents, which are mostly active during the night. Further, the Common Monitor as well as the other terrestrial species mentioned above do not seem to have a liking for an amphibian diet: they probably prey upon frogs and toads in nature, as a last resort only. Vogel [REPTILE LIFE. Translated by Margot Schierl (1958): 32] has justifiably remarked that very few of the monitors will look twice at a frog. The situation in captivity is different, and an anuran diet will not be rejected.

Varanus monitor seems to be a very hardy animal in respect of withstanding starvation. During the course of his researches at the Lucknow University, the writer managed to keep some specimens of this lizard starving for over seven months in captivity.

In the plains, the Common Monitor hardly digs a burrow for itself; it mostly occupies the burrows of rodents, or hides itself in thick vegetation or neglected buildings; it takes to ponds and pools but rarely. The writer has never seen young ones of *Varanus monitor* taking to trees; adults, when cornered, readily climb up a tree; also sometimes for the sake of eggs and chicks of birds.

RESEARCH LABORATORY,
ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
March 19, 1960.

P. L. MISRA

16. OBSERVATIONS ON THE RED EARTH BOA OR RUSSELL'S EARTH-SNAKE [*ERYX CONICUS* (SCHNEIDER)]

I had opportunities to observe, in nature and in captivity, some of the habits of the Red Earth Boa, or Russell's Earth-snake [*Eryx conicus* (Schneider)], known in Malayalam as *mannuli* (burrower) with reference to its burrowing mode of life. It is also called *mannutheeni* (sand-eater) because of its reputed sand-eating habit, a belief which has no factual basis.

E. conicus spends the whole day buried in small crevices or holes in the ground. I once collected a specimen from a burrow nearly 1½ feet (45 cm.) below the surface in loose sandy soil. It is nocturnal in its habits and moves out at night in search of prey consisting of mice, field rats, toads, small lizards, and birds, which it kills by constriction. It cannot endure long periods of starvation.

The dark brown patches on the back of *E. conicus* are bordered by luminous white margins, which would obviously be more discernible to other nocturnal animals than the blotches. This probably helps it in securing its prey.

The visual power of *E. conicus* is as good as that of any other snake, and when underground and unable to see in the darkness it can perceive even the smallest sound vibrations made on the ground. It will remain buried for hours on end in captivity with only the snout and the eyes exposed, retreating into the sand and burying itself completely at the slightest disturbance. It can remain underground for nearly an hour at a stretch. Unlike the common land snakes, *E. conicus* does not protrude and retract its tongue repeatedly; it does so only when it is subjected to considerable physical irritation. This indicates that the tongue is not used much in the way of a sense organ.

E. conicus shuns bright sunlight, and recedes into the dark corner of a partially illuminated cage. I have, however, seen it occasionally basking in dim sunlight. Burrowing in sand is usually a matter of a few minutes, and in consequence *E. conicus* is more at home in sandy soil. It is nevertheless not quite rare elsewhere. While burrowing the body is thrown into lateral folds; the burrowing is initiated by the head, and is doubtless facilitated by the scooping action of the lateral folds and the slightly prehensile tail.

In captivity *E. conicus* is gentle and well-disposed, becoming active only when artificially irritated or at night or during the capture of prey. The body is ordinarily cylindrical. Under provocation it assumes the threat posture and the body becomes dilated, turgid, and plano-convex in shape; one row of outer scales on each side is pressed on the ground, distending the costals and making the lateral spots stand out more vividly. With the lateral spots completing the gaps in the picture the resemblance to the Russell's Viper [*Vipera russellii russellii* (Shaw)] becomes very strong, earning it the name of *payyanamandali* (from *payyana*, the vernacular name of a plant the leaf-scars of which bear a peculiar resemblance to the spots of *E. conicus*, and *mandali*, viper). The flattened lower surface helps it to get a better grip of the ground. One specimen, which remained with me for some time in captivity, used to press its flanks to the ground along the whole length of its body. The mechanism involved in this dilation of the body is under investigation. Another threat posture takes the form of throwing the body suddenly into coils under which it hides its head.

DEPARTMENT OF ZOOLOGY,
ST. JOSEPH'S COLLEGE,
DEVAGIRI, CALICUT 4,
March 28, 1960.

K. G. ADIYODI

17. MATING BEHAVIOUR OF THE BEETLE *HYDROPHILUS OLIVACEUS* FABRICIUS

Hydrophilus olivaceus Fabricius belongs to the family Hydrophilidae, order Coleoptera. It is found in the local ponds and comes to light in large numbers. Some of these adults were collected and put in small water tanks and their mating behaviour was studied by the author in the laboratory. One pair was isolated in a glass tank. Externally there is not much difference between male and female beetles except that the males are generally smaller than females. The male rides over the female holding the elytra at the sides by its forelegs, mid- and hind-legs free and the mouth parts rubbing the groove between prothorax and mesothorax. During mating, the female swims while the male keeps on riding over her. The union is effected by the full extension of the aedeagus by the male which touches the female genitals. The female does not protrude its genitals as in some orthopteran insects and makes no copulatory movements. The male succeeds in inserting the aedeagus in the female genitals only after many unsuccessful attempts. At the time of complete union of the two genital armatures, the female does not move but remains stationary. The full union hardly lasts even forty seconds. After mating the male comes up at the surface to take air and very soon returns to the female to mate again. A cracking sound is made by the male when he approaches the female. The sound produced is very feeble and is audible to the human ear at a distance of about one foot only. The female does not chase the male for copulation. It has been observed that the male keeps on riding over the female for hours if the female comes to the water surface quite often. At intervals the frequency of mating is once for every minute and is continued for many days even without any food.

DEPARTMENT OF ZOOLOGY,
BIRLA COLLEGE,
PILANI, RAJASTHAN,
August 30, 1960.

S. N. MATHUR

18. MIGRATIONAL FLIGHTS OF THE COMMON INDIAN CROW BUTTERFLY [*EUPLOEA CORE* (CRAMER)]

In this note I record two migrational flights of the Common Indian Crow butterfly [*Euploea core* (Cramer)] through Bombay, one in a northerly direction seen on 20 June 1960, the second in a southerly direction seen on 23 July 1960.

Since January 1960 I am observing the movements of certain species of butterflies, including *E. core*, in my garden on Pali Hill. I watch from a window on the first floor. Observations are confined to the patch of garden directly in front of the window, measuring roughly 50 ft. by 55 ft. (*c.* 15 by 16 m.). On the north the area under observation is cut off from the adjoining compound by a dense line of mango trees, a 4 ft. (*c.* 1 m.) high rubble wall, and low bushes. On the west runs a municipal road, about four feet (*c.* 1 m.) below the level of the garden. Further west, across the road, there slopes down for about 60 yards (*c.* 55 m.) a piece of waste land surrounded by mango trees with a few mango trees scattered over it, largely stripped of their leaves and smaller branches by foraging goat-herds and fuel-hunters. On the south the garden extends about 70 ft. (*c.* 21 m.) more and is separated from the garden next door by a brick wall and a line of trees of various kinds. On the east of the observation area is my house, which extends about 30 ft. (*c.* 9 m.) further south. Observation is done in watches of 15-minute duration scattered throughout the day.

From the beginning of March, the population of *E. core* was low. In fact, in April I saw only three *E. core* in 97 watches and in May none at all in 73 watches. In 25 watches from the 1st to the 19th June, I saw only one butterfly at all resembling *E. core* but could not identify it with certainty. The first sign of a change came in the morning of 20 June when I noticed one *E. core* flying slowly round in the garden settling on the flowers. Then in my 11.45 to 12.00 watch I observed two *E. core* both flying north, at a height of about 20 ft. (*c*. 6 m.) above the ground. This was followed by 19 *E. core* in the 12.05-12.20 watch, all flying north at heights varying from 15 to 30 ft. (*c*. 5 to 9 m.) above the ground. From my post of observation I could see a similar flight taking place over the waste land beyond the road. The butterflies flew steadily and slowly forward at about 6 to 7 miles (*c*. 10 to 11 km.) per hour. They seemed to take no interest in their surroundings or in each other, except for three over my garden which flew round and round each other for a little while at the same time moving forward slowly to the north. At 13.00 hours, after lunch, I went into the garden. There was no flight in progress and only one *E. core* was to be seen flying slowly from flower to flower in the garden. I went to the waste land across the road and to a more open piece of land further down, but observed no *E. core* in either place. In my next watch, from 13.40 to 13.55 hours there were 4 *E. core*, 3 flying high and steadily north like those previously observed and one flying low and moving slowly about in the garden.

At the time of these observations there was a slight breeze blowing from the west. The temperature in the shade was about 30.5° C. Rain-clouds covered the sky; the sun showed through in the first watch but was obscured throughout the other two watches. There was no rain.

On the 21st and on subsequent days I continued my watch in the garden and kept a look-out for *E. core* while moving about in Bombay. I saw a few *E. core* flitting about at a low height; there was nothing resembling a migratory flight. This position continued till the 23rd July, when there was a sudden increase in numbers. The main flight this time was from north to south, but it was not as purposeful and uniform as on the previous occasion; also, the butterflies flew more slowly, about 4 to 5 miles (*c*. 6 to 8 km.) an hour, and after coming over the line of mango trees along the northern boundary of my garden they came down lower than on the 21st June, some of them to about 10 ft. (*c*. 3 m.) height. My observations on this day can most conveniently be given in tabular form (Table I).

TABLE I

Time of observation	No. seen and direction of flight							Sun	
	S	N	SE	SW	W	E	F	showing min.	obscured min.
11.40-11.55	13	—	2	—	—	—	2	6	9
12.15-12.30	3	2	—	—	1	1	3	0	15
13.45-14.00	—	1	—	1	—	—	3	15	0
14.20-14.35	3	—	—	—	—	—	2	15	0
Total ..	19	3	2	1	1	1	10	36	24

Note: In the column headed F are shown butterflies which flitted about in the garden.

It will be seen that of the butterflies observed 10 flitted about without flying in any definite direction. Of the rest 19 flew south, 3 north, 2 south-east, 1 south-west, 1 west, and 1 east. I did not notice any flight over the waste land across the road on the west. Between 12.30 and 13.45 hours I visited the open land to the east of my house; there was no flight in progress and only 2 *E. core* were to be seen, flitting about from plant to plant.

The 23rd July was a cloudy day, with no rain, still during the first three watches and a westerly breeze in the fourth watch. The sun was obscured for the greater part of the first watch and the whole of the second watch, and shone throughout the third and fourth watches. The temperature in the shade was about 32.5° C. during these four watches.

On the 24th July, 1 *E. core* was flitting about in the garden at 7.33 a.m. and in six watches later in the day only 2 *E. core* were seen, both flitting about in the garden. Heavy rain interrupted watching from the 25th to the 27th. In the rest of July and in August, the numbers of *E. core* seen were low. In September numbers increased. Table II summarises the changes in population from January to September.

It will be seen that between the two migrations observed by me, and immediately before and after them, the population of *E. core*

TABLE II

	Jan.	Feb.	Mar.	Apr.	May	June			July			Aug.	Sept.
						1-19th	*20th*	*21-30th*	*1-22nd*	*23rd*	*24-31st.*		
No. seen	4	53	10	3	0	0	25	3	4	37	6	4	33
No. of watches	61	124	114	97	73	25	3	20	22	4	21	56	48

in my area of observation was small and was not sensibly increased, and in my movements in the city of Bombay I saw very few *E. core*. So it seems likely that Bombay merely lies on the line of migration, outward and return.

Looking through old issues of the Society's journal I find that the northward migration of *E. core* has been observed several times. Aitken (1897, 1901) saw it in at least eleven separate years and reported two specific instances. The earlier report, sent from Ratnagiri, relates to a migration which began on 7 June 1897, but it is not clear at what place the migration was witnessed. The second migration was observed by him from the Esplanade in Bombay on 22 July 1900. The usual date for the northward migration is in the beginning of June according to him, but in 1900 the migration occurred later under peculiar weather conditions. His experience was that the migration continues through one day and sometimes goes on for a second day. The northward migration seen by Miss A. Ghose in Bombay on 13 June 1937 is described as having lasted for only two hours, but must have been on a vast scale as her estimate of the insects that passed through in that time was 30,000 (Williams, 1938, appendix). Of the return journey I can find only one previous report (Aitken, 1898). It was observed over Bombay in July 1898, first noticed on the 26th at 4 p.m., resumed in the early morning on the 27th, and continued till 'the afternoon at least'. The migrations seen by me were on a much smaller scale than those formerly reported, both as to duration and as to the number of insects seen. But they pose the same questions as were put by Aitken long ago: where do the butterflies come from? where do they go? Do the same insects perform the return journey or the immediately following generation as Aitken guessed? why do they migrate? and so on.

Davidson & Aitken (1890) report that in June 1889 in Karwar *E. core* was seen in great numbers which 'almost amounted to a plague', it disappeared in July, and was found again from August onwards. Apart from Aitken's report from Ratnagiri, I have ascertained from some residents of Ratnagiri that the phenomenon of migration is well known in that district. These facts suggest the possibility that Kanara and its neighbourhood are the starting place of the outward migration and the destination of the return migration, and that the route lies along or near the western sea-coast of India. Observations in this area may be fruitful of results.

Aitken (1897) mentions that the villagers connect the northern migration with the approach of the monsoon. In this connection his observation of July 1898, published under the heading 'Butterflies as weather prophets', is interesting. The weather conditions in that year were very gloomy. There was no storm in May, not even distant thunder and lightning. Apart from heavy but irregular rain for about a week, there was very little rain in June. After squally weather on the 12th June and for a few days thereafter the weather set fine and, to the despair of everybody, there appeared to be no prospect of more rain. In these circumstances, when Aitken on seeing the migration on the 22nd July told a friend: 'It is all right—the monsoon is coming in three days', he was ridiculed. But his prophecy came true. On the very next evening there was a heavy shower of rain, there were thunderstorms on the next four evenings, and the monsoon 'broke regularly' on the 28th and continued satisfactorily thereafter. Aitken's conjecture is that the butterflies fly north to escape 'the heavy rain with which the monsoon opens on the southern coast' (Aitken, 1898). Examination of the figures of rainfall in 1897 and 1937 as recorded at the Colaba observatory gives the following results. In 1897, when the migration was observed on the 7th June, the rain started on the 6th and continued steadily to the end of the month with only four days on which there was no rain. In 1937, when the migration occurred on the 13th June, rain started on the 12th June and continued to the end of the month without a break of a single day. Apparently, therefore, there is some connection between the northward migration and the onset of the monsoon. But in 1960, ignoring a few scattered showers in May and the first light rainfall in June, the monsoon began about the 13th June, that is to say about a week before the northward migration. It does not necessarily follow that the belief of the villagers is mistaken, for Bombay is merely on the route of the migration; to attempt an answer to the question we want to know the weather conditions at the start and at the turn of the migration.

The migration appears to be comparatively limited in its extent, and regular in its occurrence. The metallic gold (sometimes silver) chrysalis of the butterfly, the distinctive marking and shape of its wings, and its leisurely flight make it easy to identify and to observe. It therefore provides an excellent opportunity for probing into the motive causes of insect migration, a problem that is still imperfectly understood. The first requisite is to ascertain the starting and turning points of the seasonal movements, and the routes followed on the outward and the return journey, together with relevant details about dates and local weather conditions. Every scrap of information will help; observers willing to take part in collecting material should address their reports to the Society. Details of the points on which information is desired are set out in the Editorial Note appended to Miscellaneous Note No. 16 at page 430 of the Society's *Journal* Volume 57, No. 2.

To assist those who may desire to help in collecting material it will be useful to complete the analysis of the reports which I have found in the literature consulted.

October appears to be a month in which *E. core* may be expected to be on the move. Prall (1898) reports that on 21 October 1897 he saw a procession of *E. core* 'passing down the harbour' (? going south) at Mody Bunder in Bombay. 'Many hundreds' must have passed in the hour during which he was watching. Andrewes (1909) reports that on 18 October 1908 in Ouchterlony Valley in the Nilgiris he saw *E. core* 'by thousands' floating high over the treetops of the dense forest, all without exception going west. This went on for the four hours that he was there. Three days later, on the 21st, hardly an *Euploea* was to be seen. Wall (1921) on 28 October 1921 witnessed an eastward flight at sea during a voyage from Karachi to Bombay. The flight went on all day and was particularly thick opposite Madiapur on the Kathiawar coast, about 5 to 6 miles (*c.* 8 to 9 km.) from land. Several species were seen, and among those identified was one '*Euploea*, probably *core*'. As the nearest land to the west is some hundreds of miles distant he conjectured that the butterflies were 'blown out to sea by a strong current and driven back by a reverse current'.

Other observations are a flight to the south-east on 28 March 1909 witnessed by J. Evershed at Kodaikanal in south India

(Williams, 1938, at p. 445), and one to the east in July 1922 witnessed by Tulloch at Deolali (Williams, 1938, at p. 449). My observations showed rises in February and September, but no mass movement.

49, Pali Hill,
Bandra, Bombay 50,
October 29, 1960.

D. E. REUBEN

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19. *PLUSIA* (*PHYTOMETRA*) *NI* HB. (NOCTUIDAE) AS A PEST OF CABBAGE, *BRASSICA OLERACEA*, IN SOUTH INDIA

For the past few years a green semilooper, *Plusia ni* Hb., has been found to inflict serious damage on the crop of cabbage (*Brassica oleracea*) in Madurai district. Since the insect has been noted for the first time in south India as a serious pest on cabbage, a crop which is grown on a commercial scale on the hills and in the plains, a short account of it is given in this paper.

DISTRIBUTION. Hampson (1894) has given San Domingo, Europe, St. Vincent (Cape Verde Is.), Aden, Japan, China, and north-west India as its distribution. Fletcher has stated that it occurs throughout India, but the records of its occurrence extend only to Pusa, Lahore, Surat, Kumbharia (Bombay), United Provinces, Gujarat (Fletcher, 1921), and Dehra Dun (Gardner, 1947).

It is of interest to note that Fletcher (1921) has recorded a few species of the genus *Plusia* (*Phytometra*) as occurring on cabbage in N. India; they are *Plusia ni* Hb. in Surat and Kumbharia (Bombay), *P. chalcytes* Fb. in Kumbharia (Bombay), *P. orichalcea* Fb. in Poona, Nagpur, Pusa, etc., and *P. signata* Fb. in Bihar, but he is doubtful about the correct identification of the last named species.

FOOD PLANTS. Larvae of *Plusia ni* Hb. were noted on cauliflower in Pusa, and Lahore, on cabbage in Surat and Kumbharia

(Bombay), on opium poppy in United Provinces and Gujarat, and on safflower, nettle, and *Solanum* (Fletcher, 1921). In the insect collections at the Agricultural College and Research Institute, Coimbatore, it is seen that a few specimens have been collected on Sunflower (*Helianthus annuus*) at Coimbatore by R. N. Chari in 1923. Gardner (1947) has noted the larvae on *Antirrhinum*, cabbage, and tomato in Dehra Dun. The insect has now been noted to be a severe pest of cabbage in Madurai district (Madras State), and it has not been observed to feed on any other plant in this locality.

NATURE OF DAMAGE AND SEASONAL OCCURRENCE. During the last 4½ years this insect has been found to appear regularly from September to April on cabbage in Periyakulam, parts of Tirumangalam, Nilakottai, and Dindigul taluks of Madurai district, where cabbage is grown on a commercial scale in about 2000 acres (*c.* 800 hectares). The caterpillars appear both in the nursery and on the planted crop, and eat away the leaves leaving only the veins and midribs. In severe cases the crop had to be ploughed in. The damage is marked when the caterpillars attack the crop at the time of formation of heads. About 30-60% of the yield is affected.

Since the insect has assumed serious proportions in this area and the other common pests of this crop are not known to cause such severe damage it is considered to be of major economic importance for cabbage.

LIFE-HISTORY. The female moth lays greenish white, spherical, sculptured eggs singly on the undersurface of the leaves. The caterpillar is slender and attenuated anteriorly and moves as a semilooper. It feeds gregariously on the leaves and when full-grown measures about one-and-a-half inches (*c.* 38 mm.) in length and is green in colour with light wavy white lines and a broader lateral stripe. It pupates on the undersurface of the leaves in a thin transparent silken cocoon.

The moth is stout, brown in colour, with light wavy markings and with a more slender Y-mark on the forewings.

NATURAL ENEMIES. So far no parasites or predators have been noted on this insect in this locality.

CONTROL. The widespread attack by this pest made the cultivators try control with chemicals. In the early years, the cultivators either dusted with 5% DDT or sprayed with 0.25% DDT. In course of time as this did not give satisfactory results the cultivators tried spraying Endrex 20 E.C. at 1 oz. (*c.* 28 gr.) in 6¼ gallons (*c.* 28 litres) of water and parathion 0.025% [Folidol 1 oz. (*c.* 28 gr.) in 12½ gallons (*c.* 56 litres) of water]. As these chemicals control the pest and the plant lice as well, these methods are widely followed by the cultivators. They have been advised to handle the chemicals with care as they are poisonous and to stop the application a month before the harvest of the crop to eliminate residue hazards. An insecticidal trial with a view to control the pest effectively without any residual effect, as it is a vegetable crop, is worth pursuing.

ACKNOWLEDGEMENTS. My thanks are due to Dr. M. G. Ramdoss Menon, Ph.D., Systematic Entomologist, New Delhi, for permitting me to study the collections at the Indian Agricultural Research Institute, New Delhi, and to the Director, Commonwealth Institute of Entomology, London, for identifying the insect. Thanks are also due to Dr. S. Kanakaraj David, Ph.D., Reader in Entomology, and to Sri K. R. Nagarajan, B.Sc. (Ag.), Crop & Plant Protection Officer, (Entomology), Coimbatore, for their kind help and valuable suggestions in the preparation of this note, and to Sri R. Subbiah Pillai, B.Sc. (Ag.), District Agricultural Officer, Madurai, for encouragement and facilities given in making the observations.

POST-GRADUATE TRAINING CENTRE,
COIMBATORE-3,
August 2, 1960.

B. VASANTHARAJ DAVID

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20. *SYNGAMIA ABRUPTALIS* WALKER (PYRALIDAE—LEPIDOPTERA): A NEW PEST OF *MENTHA VIRIDIS* L. IN SOUTH INDIA

INTRODUCTION

Mentha viridis L. (Labiatae) (Tam. *Podina*) is a small perennial herb commonly grown in kitchen gardens and used for seasoning many culinary preparations. The thick, fleshy leaves are used for making *chutneys*, for flavouring soups, salads, etc. It has a medicinal value and has been used for curing hysteria and some infantile troubles. So far no insect has been noted as doing any marked damage to the plant. Recently, however, the caterpillars of the moth *Syngamia abruptalis* Walker were observed causing the withering of the plants on a large scale in the orchard attached to the Agricultural College and Research Institute, Coimbatore. Since it is recorded here for the first time, the observations made are given below.

PREVIOUS RECORDS

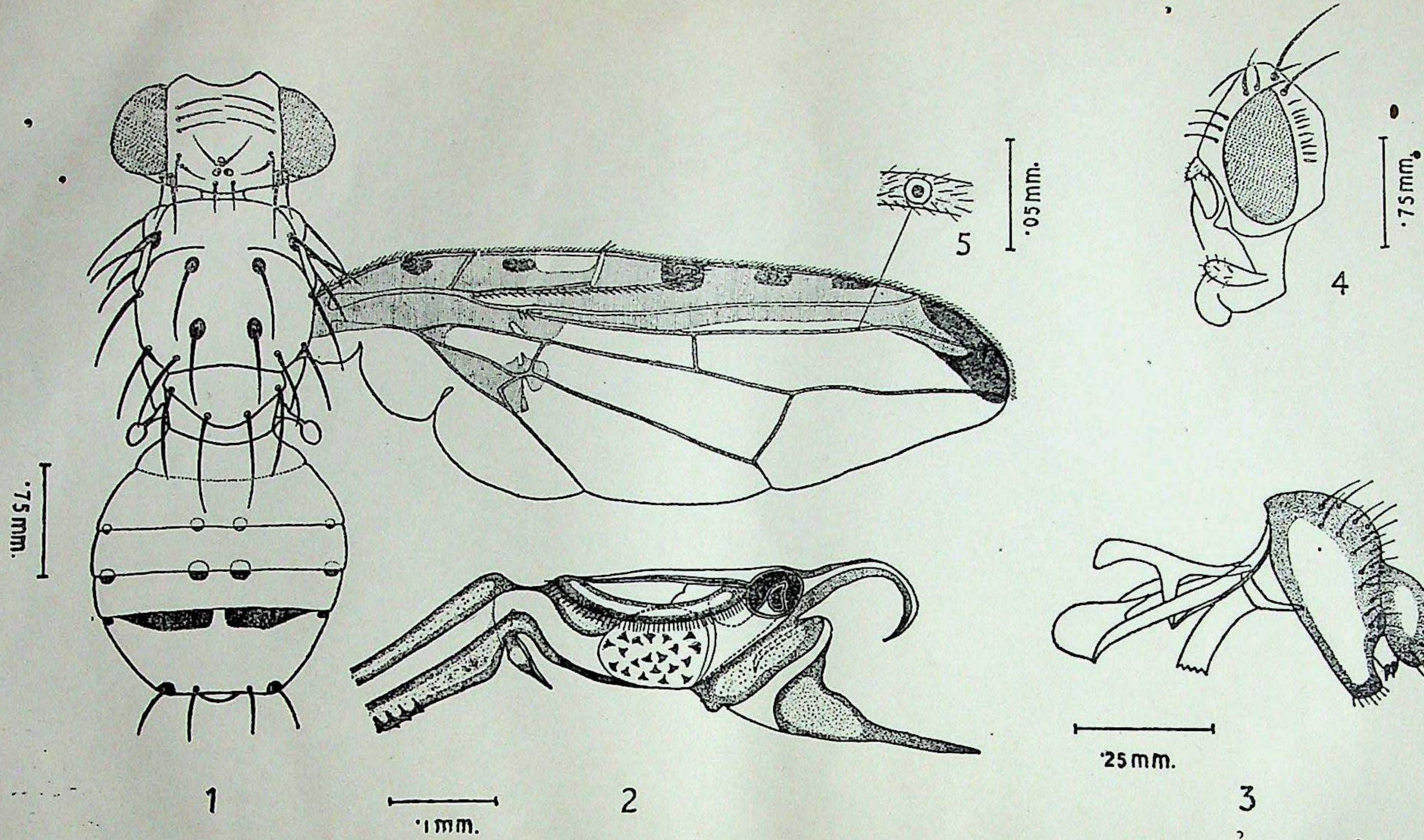
Lefroy (1909) noted the insect on *Ocimum sanctum* L. (Tam. *Thulasi*). It has, however, not appeared in any large proportions on this plant. No further information is available on this insect from India. Shroff (1919) mentioned it as 'not a serious pest' on the leaves of mint, in Burma. According to Zacker (1913) it is a leaf-feeding pest of cotton, in Africa.

CHARACTERISTICS OF THE INSECT

The caterpillar folds the leaf in a characteristic way and feeds inside. The edges of the leaf are brought together and folded along the midrib in the longitudinal axis. The edges are united by silk filaments, and the doubled leaf is seen as a flat one. Many leaves in the terminal shoot are also loosely webbed with stray strands of silk. The caterpillar rests near the midrib with its head pointing towards the stem, and scrapes the parenchyma in the inner portion of the folded leaf, leaving the lower epidermal portion intact. It attacks 2 or 3 leaves in the same branch before it attains full growth. The folded skeletonised leaves gradually wither away. Consequently, the branch where it has been feeding dies. Two or three caterpillars have been noticed on different leaves in the same branch.

The fully-grown caterpillar measures 22 mm. in length. The head capsule is light yellow to light brown in colour. The body is pale green in the young stage, but turns yellowish later. Black spots with hairs are present on the dorso-lateral aspect in the thoracic and the first 8 abdominal segments. There are also short hairs arising singly in other portions of the body. On disturbance the caterpillars move quickly in jerks and hang on silken threads. Just before pupation red patches are developed around the dark spots on the body.

Pupation takes place inside the leaf-fold in a white cocoon made of a few strands of silk. The pupa is brown, about 8.5 mm. in length, and is attached to the leaf by the anal end.


1
·75 mm.
2
·1 mm.
3
·25 mm.
4
·75 mm.
5
·05 mm.

Craspedoxantha indica sp. nov.

. Adult male ; 2. Aedeagus (lateral view) ; 3. Genitalia (lateral view) ;
. Head (lateral view) ; 5. Sense organ, enlarged.

The moth is orange-brown, with the forewing crossed by a black curved antimedial line and irregularly undulated postmedial line, which curves below and touches a black streak. The hind wing is crossed by two medial blackish wavy lines and a marginal line in black. Outer borders of the wings are darkest in colour. The fore legs are whitish with black bands. The wing expanse is 6/10-7/10 in. (*c.* 15-17 mm.).

Economic Status

The insect appeared in large numbers on a bed of mint in the orchard and completely damaged the crop in one month. It occurred in May and June by which time all the plants had been affected. It thus seems to be a serious pest of the crop.

Acknowledgement

The authors are thankful to Dr. S. Kanakaraj David, Reader in Entomology, Post-Graduate Training Centre, Coimbatore, for having given valuable suggestions in preparing this paper.

POST-GRADUATE TRAINING CENTRE,
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July 7, 1960.

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21. A NEW SPECIES OF THE GENUS *CRASPEDOXANTHA* BEZZI, 1913, FROM INDIA (DIPTERA: TRYPETIDAE)

(*With a plate*)

The genus *Craspedoxantha* was first erected by Bezzi in 1913 with *Craspedoxantha octopunctata* as the type. The description of the genus was based upon a single female specimen from the Dawna Hills (Lower Burma), collected in 1908. This species was subsequently recorded from Bangalore (Senior-White 1922) and from Delhi (Bhatia 1939) and I am glad to be able to describe a new species.

Craspedoxantha indica sp. nov.

MALE. General coloration of the body cream-yellow; length of body 4.13 mm.; wing 4.62 mm. long, 1.47 mm. broad, 3.14 times as long as broad.

Head. Length, width, and height of the head, 0.86 mm., 1.44 mm., and 1.19 mm. respectively; frons slightly convex, 0.57 mm. long, 0.75 mm. wide, 1.2 times as long as the maximum width of either eye; face concave; eyes scarlet-red, sharply contrasting with the cream-yellow colour of the head; each eye in profile 0.92 mm. high and 0.48 mm. wide, 1.9 times as high as wide; third antennal segment with its ventral side gently curving towards the dorsal apex; length of second segment 0.19 mm., length of third segment 0.29 mm., the third segment 1.5 times longer than the second; the antennal segments concolorous with the head, arista brown and 0.38 mm. long; proboscis capitate; maxillary palpi moderately broad with a few very fine yellow bristles; premental plate (theca) concolorous with the proboscis which is cream-yellow; ocellars yellow; lower orbitals three, yellow; upper orbitals two, yellow; inner verticals yellow; outer verticals yellow; postocellars pale, scale-like; postverticals pale, scale-like; postorbitals (occipital row) consisting of approximately ten, pale scale-like, small bristles; genals yellow.

Thorax. Dorsum of thorax light reddish yellow and covered with very short white hairs; the notopleural calli, the humeral calli, the pleurae, and the scutellum cream-yellow; mesosterna and metasterna reddish yellow; prosternum cream-yellow; scutellum 0.42 mm. long, 0.81 mm. wide, the apical half of the scutellum bearing small, dark brown hairs; two pairs of black spots forming a square in the middle of the dorsum of thorax behind the suture and bearing the dorsocentral and prescutellar bristles; one black spot just postero-ventral to the presutural bristle; one black spot ventral to the anterior supra-alar bristle; one black spot posterior to the first posterior supra-alar bristle, situated between the latter and the basal angle of the scutellum; one black spot just postero-dorsal to the wing-base; a pair of black, coalesced spots at the antero-mesal aspect of the mesosternum; legs cream-yellow; fore femora underneath with a longitudinal row of seven strong yellow bristles, dorsally with two longitudinal rows of moderately developed bristles; hind femora with four asymmetrically placed yellow bristles on the dorsal side near the end; hind tibiae with a comb-like row of stout, yellow bristles situated longitudinally on the dorsal side and pointing anteriorly; scapulars with no definite number; humerals pale; anterior notopleurals pale; posterior notopleurals pale; presuturals pale; dorsocentrals pale, situated slightly anteriorly to the anterior supra-alars and longitudinally in line with the prescutellars; anterior supra-alars pale; posterior supra-alars two pale; mesopleural, pteropleural, and sternopleural pale, one each; scutellars four pale; wings with all the veins, except the second brown-yellow; second vein creamy-white; first vein bristly; third vein bare, but with a few (approximately four) bristles at the base; costal bristles two, one of them being comparatively smaller; wing pattern as shown in the figure.

Abdomen. Colour of abdomen cream-yellow, the terga being slightly darker; first tergum abundantly clothed with short white hairs, the rest of terga with dark brown hairs, which are stouter along the lateral margins; pregenital part of the abdomen 1.69 mm. long, 1.67 mm. wide, 0.67 mm. wide at the base; fifth tergum 0.57 mm. long, equal to the preceding two terga in length; the genital segments also cream-yellow, except the black teeth of the outer claspers; a black spot on each antero-lateral angle of terga 3 to 5, the spot on tergum 3 being more or less concealed by the preceding tergum, the spots on terga 4 and 5 being partly so; a black spot on anterior margin of terga 3 and 4 close to the mid-longitudinal line of the abdomen, the spots on tergum 3 being more or less concealed by the tergum preceding, those on the tergum 4 are partly so; a moderately broad black border along the anterior margin of tergum 5, bluntly interrupted in the middle and tapering laterally towards the black spot at the antero-lateral angle of tergum 5; a black spot on postero-lateral angle of tergum 5 bearing a bristle; surstyli not bifid or lobate; the genital ring with a hood-like structure in its anterior one-third; flutella pronged; the details of the genital structures and the aedeagus as shown in the figures.

FEMALE: Unknown.

HOLOTYPE: One male, in personal collection (ZR 1), collected while sitting on the leaves of *Xanthium strumarium* (Compositae), 4.7.1959.

HOST: Unknown.

LOCALITY: University Campus, Aligarh, India.

DISCUSSION

This species resembles *Craspedoxantha octopunctata* Bezzi in its 8 black spots on the thorax, and in the wing pattern, but it differs in the following characters:

1. 12 black spots on the abdomen (besides a black border along

the anterior margin of the fifth tergum); in the genotype the abdomen is uniformly reddish yellow.

2. The thorax is light reddish yellow and not dark ferruginous.
3. The scutellum is cream-yellow and not dark ferruginous.
4. The occiput is pale without any grey pollen.
5. There are two upper orbitals instead of one (in this connection a re-examination of the genotype is highly desirable which unfortunately is not available).
6. The 2nd vein is creamy-white and not yellow.
7. A double longitudinal row of bristles on the dorsal side of the fore femora.
8. Four asymmetrically placed bristles on the dorsal side of the hind femora near the end.

ACKNOWLEDGEMENTS

The author takes this opportunity to express his grateful thanks to Prof. M. B. Mirza for providing all facilities in his department, and to Dr. S. M. Alam for his interest and encouragement.

DEPARTMENT OF ZOOLOGY,
ALIGARH MUSLIM UNIVERSITY,
ALIGARH,
August 4, 1960.

MD. ZAKA-UR-RAB

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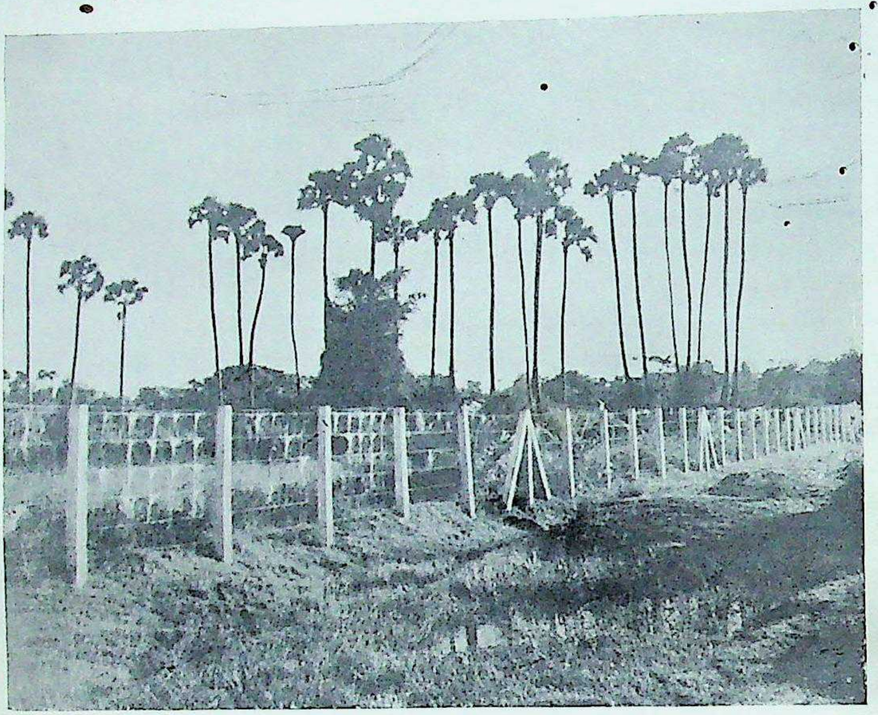
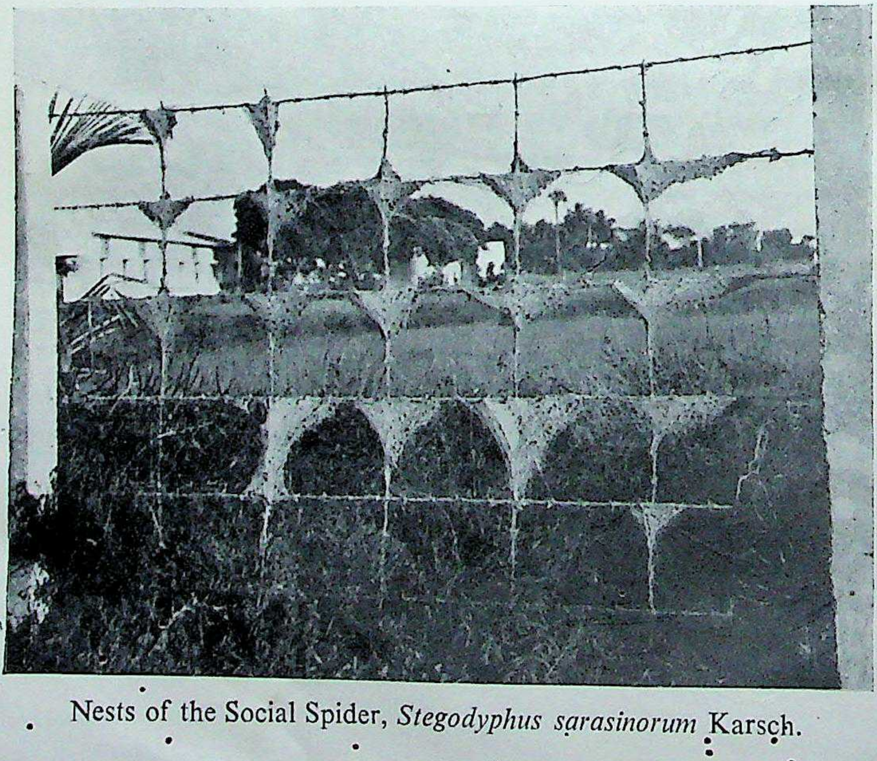
22. UNUSUAL NEST-SITE OF THE SOCIAL SPIDER, *STEGODYPHUS SARASINORUM* KARSCH

(*With a plate*)

The nest of the Social Spider, *Stegodyphus sarasinorum* Karsch (Family Erisidae), is a familiar sight in the scrub jungles of Tambaram. The nests are usually constructed on shrubs and trees with a preference for those with thorns and for rough-stemmed plants, like *Grewia* (Tiliaceae) and *Atalantia* (Rutaceae), and more rarely on the prickly pear plant as observed by Jambunathan (1905) and Savory (1928).

An unusual nest building site was noticed by me on the barbed wire fencing of a compound about a mile north of Tambaram. Here





Nests of the Social Spider, *Stegodyphus sarasinorum* Karsch.

the nests were 65 in number, of which about 50 were inhabited and the rest deserted. The nests were built round the crossing of the barbed wires, and the houses had a compact laterally compressed triangular shape, with an average thickness of 20 to 25 mm. and the edges almost touching each other.

Although the barbed wire fencing extended to over 300 yards (*c*. 275 m.) all the nests were close together and built on adjacent wire crossings. The house was in the centre with several openings all round, but the net-like expansion with sticky threads covered the intervening space between the wires.

Each nest was inhabited by about 40 individuals on an average, with more males than females. The males were smaller (6 mm.) than the females (8 to 9 mm.). Both the sexes were of ashy grey colour resembling the surroundings, i.e. the colour of the nest. They were found to be more active just before dusk and at night. When an ant was thrown on the nest several of them came out to drag it in. The study of the exoskeletal remains of insects found in the nest could be a study by itself and would give a clue to the insect fauna in that locality. Remains of Chrysomelid beetles, dung-rollers, water beetles, termites, plant bugs, noctuid moths, and flying ants are among the more common ones, and some of their exoskeletons are preserved almost entire, making identification easy.

The month of March seems to be a period of prosperity and breeding for these spiders. In every nest were found 5 to 9 egg-cases. Each egg-case, a circular disc of fine silk and 4.5 mm. in diameter, was left stuck to the inner wall of the house. These were invariably guarded by females, who took up a threatening attitude when disturbed. Some nests had newly hatched young, which were also guarded in a similar way by the females.

These observations were made while going round on the survey of the Arachnida of Tambaram and its environs, which was undertaken with a grant for field work from the Bombay Natural History Society.

DEPARTMENT OF ZOOLOGY,
MADRAS CHRISTIAN COLLEGE,
TAMBARAM, CHINGLEPUT DIST.,
July 9, 1960.

G. J. PHANUEL

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[C. E. C. Fischer in a note on this species (*J. Bombay nat. Hist. Soc.* **18** : 207) stated that he had no evidence of these spiders attacking any insects struggling in the web and believed that they either allowed the trapped insects to die or waited till it was quite helpless with starvation.—EDS.]

23. AN UNUSUAL METHOD OF CURING SCORPION STINGS

My attention has been drawn to a note in *The Times* of the 13th June 1960 (late London air edition) entitled 'An Indian Painkiller'. When the correspondent, probably an ex-I.C.S. man, was sitting with one Agarwal, a Dy. Magistrate in Saharanpur, he was stung by a brown wasp. Agarwal offered to cure him with a none too clean steel-bladed paper-knife and the correspondent hesitatingly agreed. With the knife point held flat under his forefinger, Agarwal criss-crossed slowly and steadily the area of the sting, firmly scratching but never breaking the surface. Each time he was careful to ensure that the knife point crossed the exact point of entry of the sting and with each stroke the correspondent felt relieved. After a dozen passes or so, the pain had virtually disappeared. Subsequently, the correspondent used this cure successfully for scorpion and wasp stings. He also mentions an instance when his treatment was interrupted by a Sub-inspector of Police who, by similar methods, 'put back' the pain! This was however removed a few minutes later in the same fashion and one is left with the impression that the pain could be 'switched' on and off!

This reminds me of a similar experience.

About 30 years ago a cousin F. H. B. Tyabji started farming near Ahmednagar in the Bombay-Deccan. The area was a wilderness and very little medical attention was then available. Under these circumstances my cousin, with a bottle of iodine and a few standard mixtures, soon became the local doctor. Among the many complaints of various kinds which were brought to him, he found that scorpion sting was a constant occurrence. About this time, he was informed that certain signs accompanied by verses from the Koran would cure the pain and he decided to give it a trial.

A rectangle was to be drawn complete with diagonals and a triangle at the top, without lifting the instrument off the skin, the Arabic lines being recited throughout the performance.

The response was instantaneous and amazing. At the first performance the pain was said to have dropped for an appreciable distance and, if repeated two or three times, disappeared completely. A person literally writhing with pain would turn up at the farm to be treated and return happy and cured within a few minutes. Tyabji's fame spread far and wide and victims crowded to him for the 'miraculous' cure. With more experience he noticed that the designs did not have to be very carefully drawn and that he could skip portions of the prayer. Later, he would merely make passes with his hands and omit the recitations, but the cure worked just the same. I understand that he treated hundreds of cases and failures to relieve pain were very rare.

This is not all and I have an experience of my own to relate which occurred in 1948, at Chikalda. Returning from a morning's walk, I found the khansama in great agony, having been stung on the hand by a scorpion and the pain having gone up to his shoulder. On the table lay a scalpel, which I had been using for skinning birds. I picked it up and seized the victim's arm. Fearing, perhaps, some sort of amputation, the khansama shrank from me, but I merely made some passes over his shoulder, barely touching the skin. My inquiry regarding the efficacy of the cure was met by a blank stare, but I repeated my actions and was told that the pain had dropped to the elbow. A few more passes had the man completely cured, except for slight discomfort at the initial puncture. My wife was present and I do not know which of us three was the most surprised at what had happened.

I have not had another opportunity to try out this cure, but am surprised that it is not better known and has not been more closely investigated by the medical profession. I have no explanation to offer.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD, HUMAYUN ABDULALI
BOMBAY 6,
August 1, 1960.

[Fr. H. Santapau, Joint Editor, writes:

'The late Rev. J. F. Caius, Vice-President and member of the editorial board of the Bombay Natural History Society, jointly with Dr. M. S. Mhaskar published a lengthy paper on 'Notes on Indian Scorpions' in the *Indian Med. Res. Mem.* **24** : 1-102, 1932. In the preparation of the paper, the authors studied a very large number of herbal preparations commonly used in India in the treatment of scorpion sting. Of these preparations Caius and Mhaskar write: 'None of the Indian Plant Remedies popularly used in the treatment of scorpion sting has been found to have any preventive, antidotal, or therapeutic effect'.

'I asked Fr. Caius what then could be done for scorpion stings. His answer confirmed the facts mentioned by Shri H. Abdulali in the preceding note. The most acute pain is felt in the nerve ganglia in the upper arm or upper leg. Fr. Caius informed me that, using a needle or even a pointed pencil, one should make a series of scratches (without cutting the skin) beginning from the point of greatest pain; from there the scratches are to be repeated about every inch downwards to the tip of the fingers or of the toes. The scratching of the skin distracts the attention of the sufferer, so that by the time the last scratch has been made near the tip of the arm or leg, the pain has disappeared.

'In my personal experience I have found that alcohol or methylated spirit, ammonia, or even kerosene oil applied to the hand or foot and allowed to evaporate may produce the same pain-killing effects.

'One thing should be kept in mind when stung by a scorpion. 'Scorpion sting is very rarely fatal; and thus scorpions are no more dangerous to human beings than bees or wasps.' (Caius & Mhaskar, p. 98). Some of the deaths recorded in the past as due to scorpion sting are in all probability mostly due to the vivid imagination of the sufferer. The maximum amount of venom found by Caius and Mhaskar in the common Indian scorpion, *Buthus tamulus*, was only 5.3 mg.; if the toxicity of the venom in relation to body weight was the same for man as for the very susceptible English rabbit, the total quantity mentioned above would not be lethal for a greater body-weight than 2.6 kg. Scorpion venom should then not be lethal to man, children not excepted'.—EDS.]

24. A NEW SPECIES OF MOLLUSC, *GULELLA RAMBHAENSIS*, FROM RAMBHA IN ORISSA (GASTROPODA: FAMILY STREPTAXIDAE)[1]

(*With one text-figure*)

Gulella (Huttonella) rambhaensis sp. nov.

Material: One broken land shell found along with other specimens in debris lying on the beach of Rambha Bay of the Chilka

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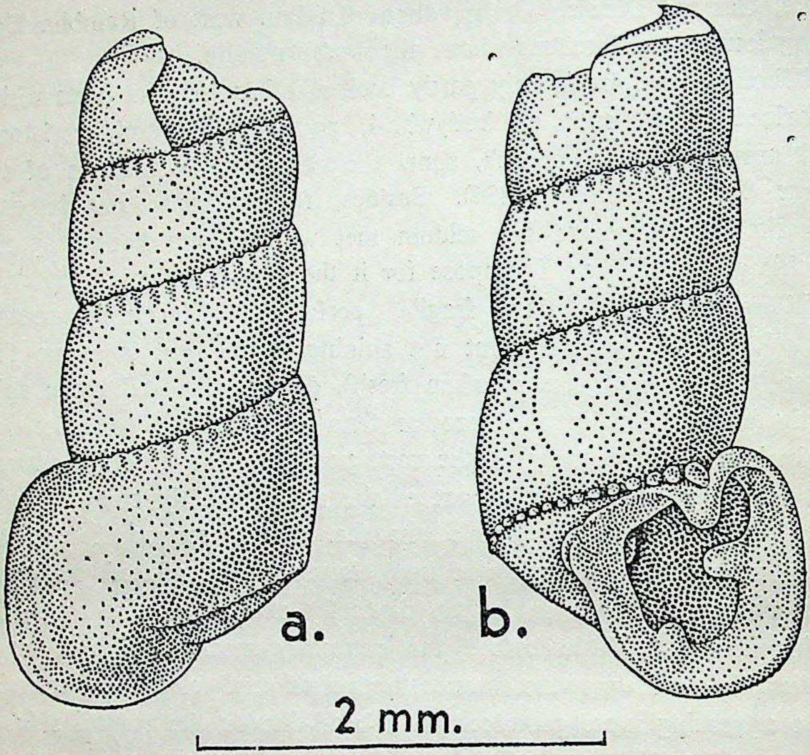
[1] Communicated by the Director, Zoological Survey of India, Calcutta.

Lake, Ganjam District, Orissa, about 0.4 km. west of Rambha Dak Bungalow and 4.8 metres above the water margin.

Though the spire is only partly broken, other essential parts which remained intact, such as bodywhorl, penultimate whorl, peristome and armature of the mouth, show the characteristic features of the genus *Gulella* Pfeiffer (1856). Besides, further study reveals such remarkable features as are seldom met with in any known species of this genus. Hence, I propose for it the new name *rambhaensis*.

Diagnosis: Shell tiny, fragile, perforate, cylindrically-turreted, dextral, smooth, polished but not shining, white (but it seems that the colour was pale cream when fresh), devoid of costulations; spire partly broken, but much narrower than in *G. bicolor* and its var. *barkudensis*; whorls only 4 (the rest, possibly 3 or 4, being entirely lost with the broken upper part of the shell), slightly convex, bodywhorl adnate as in the above two (i.e. closely connected with the penultimate whorl, though not free), larger and produced outwards, greater in width than in length, distinctly carinate at the base—the carina ending a little before the extremity marked with 2 or 3 vertical lines of growth; sutures impressed and crenulate—crenulations appearing more prominent and bead-like on the ventral side of the last suture, but gradually diminishing in size while passing round the dorsum of the bodywhorl along the carina, and ultimately terminating with it at the base; peristome white, thickened, expanded, continuous, reflected, rounded at the base somewhat as in var. *barkudensis*, truncated above, outer margin more regularly curved and expanded in the absence of external fosset, and hence extending even beyond the general outline of the body of the shell itself; parietal lamina prominent and looking somewhat like the upper part of the human ear, and ascending just above the last suture only; actual orifice trilobed—the largest lobe median and lying on the columellar side, in between the parietal tooth above and the basal tooth at the left corner below, with the other two on the outer side, the smallest lobe lying above at the upper angle and the intermediate lobe at the lower angle in between the median outer marginal tooth (or palatal tooth) and the basal tooth; parietal and palatal teeth appearing more or less equally strong, basal tooth smaller and less strong than both, but columellar plica smallest of all, deep-seated, somewhat depressed and lying just behind the largest lobe on the throat of the columella; umbilicus only slit-like and concealed from view by the expanded peristome and hence should be carefully seen from a profile view.



Shell of *Gulella* (*Huttonella*) *rambhaensis* sp. nov., from Rambha, Orissa
(a) Dorsal view; (b) Ventral view.

Measurements:

(i) Length of the broken shell	3.2 mm.
(ii) Diameter of the broken shell (round the penultimate whorl)	1.3 mm.
(iii) Length of the bodywhorl	1.2 mm.
(iv) Diameter of the bodywhorl	1.7 mm.
(v) Length of the peristome	1.0 mm.
(vi) Diameter of the peristome	1.0 mm.
(vii) Length of the actual orifice	0.8 mm.
(viii) Diameter of the actual orifice	0.5 mm.

Type specimen: Holotype. Regd. No. M 16593/2, Zoological Survey of India, Calcutta.

Type locality: Beach of Rambha Bay of the Chilka Lake at Rambha, Ganjam District, Orissa. Coll. Dr. H. C. Ray. 6-1-55.

Remarks: The new species, *G.* (*H.*) *rambhaensis*, may be closely allied to *G. bicolor* (Hutton, 1834), the most widely distributed land snail originally known from Mirzapur, U.P., and its var. *barkudensis* (Annandale & Prashad, 1920) from the Barkuda Island in Chilka

Lake, Orissa, but differs markedly from both in having the shell perforate and its spire much narrower, bodywhorl slightly more produced outwards and carinate at the base, crenulations more prominent and bead-like on the ventral side of the last suture and continued even to the base along the carina, peristome continuous and its outer margin regularly curved and more extended outwards in the absence of external fosset. For further details about *G. bicolor*, the papers of Benthem Jutting (1950) and Blanford & Godwin-Austen (1908) may be consulted.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE,
CALCUTTA-12,
September 14, 1960.

H. C. RAY,
M.SC., D.Phil., F.Z.S.I.

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25. ECTOPROCTAN-COELENTERATE ASSOCIATION: AN EXAMPLE OF UNPURPOSEFUL INQUILINISM?

While examining a catch of fishes for parasites I came across a specimen of the crustacean cymothoid isopod, *Nerocila trivittata* Bleeker, attached to the dorsal side of the fish *Otolithus argenteus*. The posterior part of the body of the parasite appeared to be covered with foreign matter which, on repeated washing, did not peel off. Consequently the specimen was examined under the microscope. What looked like dirt turned out to be an encrustation of the coelenterate hydroid, *Clytia gracilis*, with a close matting of an ectoproctan, amidst the horizontal stolons.

As observed by Dales (*Geological Society of America*, Mem. 67, p. 391, 1951) interpretation of commensalic associations is peculiarly susceptible to anthropomorphic bias, particularly because of the difficulty of applying experimental methods to determine the degree of dependence of the commensals. Hence exceptions, like the present, have importance.

Associations between animals and plants or between animals of widely different groups are described, often casually, as mutualism (symbiosis), commensalism, and inquilinism. Many sedentary animals, particularly hydroids and polyzoans, are epizoic on, i.e. they live attached to, other animals or plants, but are not parasites on them. There are records of hydroids growing on other coelenterates, polychaetes, decapods, molluscs, and fishes (Dales, op. cit.). The present record adds another, quite an unconventional one, to the list of hosts. To my knowledge a parasitic isopod has not previously been known as the host of a commensalic hydroid or ectoproctan. But the parasitic copepod, *Sarcotretes scopeli*, has been recorded harbouring the hydroid, *Ichthyocodium sarcotretis* (Jungerson, *Vidensk. Meddel. naturh. Foren.* Vol. 64, 1911). Hence, it is interesting to speculate on the origin of the association.

Many of these associations have their origin in the crowded condition of the littoral and sublittoral zones. Also, in muddy or sandy areas the only hard objects available to sedentary animals are other animals. Here competition is mainly for living space, to secure a foothold. Epizoics get attached, at random, to any solid substratum, motile or sedentary. Hence, all associations, even the most specific ones, must have originated quite accidentally. Specificity is the result of natural selection.

Nerocila has a short free-swimming existence during its male phase, but soon contacts a suitable host and metamorphoses into a female. As the fish in question is neither littoral nor sublittoral in the strict sense, the association must have started in the pelagic environment. It is well known that larvae of most sedentary organisms have a definite larval period, at the end of which they must settle or perish. In the present case the hydroid larva, compelled by necessity settled on the isopod. It has to be admitted that the isopod host is certainly more suitable than a sedentary animal or an inanimate object, as the hydroid would certainly benefit by the movement of the fish host and also get the advantage of a sedentary life. Obviously the ectoproctan is the latest guest, for usually nothing settles over a live ectoproctan colony. It is likely that the encrusting hydrorhizae of the coelenterate provided the necessary purchase for the polyzoan.

The present discovery shows that any hard surface is utilised by the larvae of sedentary organisms and the choice is solely dependent on the exigencies of circumstances. The present example should be classed as fortuitous association or 'unpurposeful inquilinism'.

MARINE BIOLOGICAL LABORATORY,
TRIVANDRUM,
July 19, 1960.

N. KRISHNA PILLAI

26. THE CORRECT NAME OF *CASSIA GLAUCA* AND ITS VARIETIES

The plant, commonly known in India as *Cassia glauca*, is a shrub or a small tree with attractive yellow or orange flowers. This plant drew the attention of some of the pioneer botanists who worked on Indian plants in the seventeenth and eighteenth centuries. Rheede (1686) described this plant under the name *Wellia-tagera* and gave two good illustrations. Burman (1768) described the plant and named it *Cassia surattensis.* The plant was described as having eight pairs of leaflets with obtuse apices and bright orange-coloured flowers. The description of the plant was based on a specimen from Garzin's herbarium and probably for this reason no reference to Rheede's *Wellia-tagera* was given. A few years later, Lamarck (1789) described the plant as *Cassia glauca*, and Vahl (1794) named it *Cassia arborescens*. Both Lamarck and Vahl have referred to Rheede's description and plate. Burman's name, *Cassia surattensis*, being earlier and conspecific with *Cassia glauca* and *Cassia arborescens*, must be accepted as the valid name for this plant. Bentham (1871), in his revision of the genus *Cassia*, agreed that all these names refer to the same species, but somehow he accepted the name *Cassia glauca*. Merrill (1923), however, indicated that the name *Cassia surattensis* should receive priority over *Cassia glauca*. In recent publications of Raizada & Hingorani (1954), the name *Cassia surattensis* has been accepted.

It would have been unnecessary to prepare this note if there was unanimity of opinion on the lines suggested above. But unfortunately, it is not so. Bailey (1949) considered that *Cassia planisiliqua*, which was published much earlier by Linnaeus himself, should be the valid name of this plant. He supported this with two earlier publications by Grisebach (1864) and by Britton & Rose (1930). The latter authors not only considered *Cassia glauca* the same as *Cassia planisiliqua*, but further decided to place the plant under a newly created genus which they named *Psilorhegma* and the plant was named *Psilorhegma planisiliqua* (Linn.) Britt. & Rose. The new genus was apparently created in view of such characters as ten perfect stamens in flowers, flat pods, and glanduliferous leaves. It was however felt that in general appearance the plant agrees very well with *Cassia* and the creation of the new genus (and thereby removing the plant from the genus *Cassia*) is a step which is rather artificial. As a matter of fact, Bailey (1949) has correctly restored *Psilorhegma* back to *Cassia*, which should be its natural and rightful place.

After a study of the available literature, it is clear that the name *Cassia planisiliqua* as accepted by Bailey cannot be considered for this plant. According to Bentham (1871), who examined the specimen of *Cassia planisiliqua* at the Linnean Herbarium and the original plates of Plumier on which the description was mainly based, the name *Cassia planisiliqua* is to be regarded as a *nomen confusum.* The Linnean diagnosis of the species given in his SPECIES PLANTARUM refers to *Cassia occidentalis.* The plate referred to by Linnaeus (i.e. Plumier ed. Burm. t. 77) is unfortunately a mixture of two or three species and does not refer at all to any known species of *Cassia.* According to Bentham: 'The leaves are those of *Cassia fistula*, the flowers quite unintelligible, the fruit more like that of section *fistula* than of any other, described as flat, whence the name, but figured as nearly terete and filled with a series of unintelligible circles described as *ossicles* or seeds, but more likely to be the transverse septa of the *fistula* section as they overlap each other. The whole species must, therefore, be passed over as an inexplicable puzzle, founded on the diagnosis of one species, with the representation of another, cooked up by an inaccurate artist, and encumbered by the description of the fruit of a third species. The plant representing *C. planisiliqua* in the Linnean Herbarium is *C. siamea*, which is certainly not the one from which he took his diagnosis.'

It would, therefore, be clear that the evidence against accepting the name *Cassia planisiliqua* is overwhelming and this name has to be rejected from our consideration. We have, therefore, to accept the next validly published name, *Cassia surattensis* Burm. f., as the name for this plant. The species has two well-marked varieties, i.e. (i) var. *surrattensis* and (ii) var. *suffruticosa.* These two varieties were considered by some as distinct species. Bentham (1871, p. 555), on the other hand, found it difficult to separate the Indian collection into two distinct varieties. He has, however, admitted the existence of two 'types' as he said: 'The Australian specimens belong to the *suffruticosa* type; they are much more variable than the Indian ones, but not in the direction of the large *glauca* type.' From an examination of herbarium specimens, these two 'types' are clearly distinguishable and should be considered as two varieties. Important points of difference between the two varieties are the presence of more numerous and smaller leaflets and strongly unequal petals in var. *suffruticosa*. The nomenclature and descriptions of these varieties with their distribution are as follows:

(i) **Cassia surattensis** Burm. f. var. **surattensis**. *Cassia surattensis* Burm. f. Fl. Ind. 97 (1768). *C. glauca* Lam. Encycl. 1: 647 (1789). *C. arborescens* Vahl (non Mill.) Symb. Bot. 3: 56 (1794). *C. discolor* Desv. Journ. Bot. 3: 73 (1814). *C. sulphurea* DC. Prodr. 2: 495 (1825). *Senna arborescens* Roxb. Fl. Ind. 2: 345 (1832).

A small tree 5 to 6.5 m.; young branches minutely pubescent becoming glabrous later; stipules subulate, acuminate, 1 cm. long; petiole 2 to 5.5 cm. long, glabrescent; rachis thinly pubescent or glabrous, with 2 or 3 short, stout, clavate glands in between lower pairs of leaflets (one gland between each lower pair); leaves equally pinnate, 15 to 22 cm. long; leaflets 4 to 6 pairs, elliptic or oblong-elliptic, ovate, entire, subacute, pinnate-reticulate veined, almost glabrous, glaucous beneath, 5-10 cm. long, 2.5-4 cm. wide; peduncles axillary, 6 to 10 cm. long; pedicels 2-3 cm. long; flowers corymbose, sepals ovate or elliptic, rounded, unequal, 8 to 10 mm.; petals 5, subequal, spreading, broadly ovate-obtuse, 2 to 3 cm. long, bright yellow-orange; stamens 10, anthers all equal and fertile, two with longer filaments; pods flat, straight, drooping, glabrous, 10 to 17 cm. long, 1.5 cm. wide, margin raised; seeds biseriate 20 to 30, oval, testa dark brown.

Distribution: India, Burma, Ceylon, Malaya, southern China, Formosa, Sumatra, tropical Australia. Cultivated also in many countries.

(ii) **Cassia surattensis** Burm. f. var. **suffruticosa** (Koen. ex Roth) Chatterjee comb. nov. *C. speciosa* Roxb. Hort. Beng. 31 (1814) nomen. *C. suffruticosa* Koen. ex Roth, Nov. Pl. Sp. 213 (1821); Koen. ex Roth in DC. Prodr. 2: 496 (1825); W. & A. Prod. 289 (1834); Benth. Fl. Austral. 2: 285 (1864). *C. horsfieldii* Miq. Fl. Ind. Bat. 1: 99 (1855). *Senna speciosa* Roxb. Fl. Ind. 2: 347 (1832). *Cassia acclinis* F. Muell. Fragm. 4: 13 (1864). *C. glauca* Lam. var. *suffruticosa* (Koen.) Baker in Hook. f. Fl. Brit. Ind. 2: 265 (1878). *Psilorhegma suffruticosa* (Koen.) Britton in North Am. Fl. 23: 255 (1930).

Cassia fastigiata Vahl (Symb. Bot. 3. 57, 1794) excl. descr. '*glandulis inter omnia paria*' probably belongs here as indicated by Wight and Arnott (*Prod.* 290, 1834) and Prain (*J. As. Soc. Bengal* 66: 477, 1897).

The varietal name *Cassia glauca* Lam. var. *suffruticosa* (Koen.) Baker (Hook. f. Fl. Brit. Ind. 2: 265, 1878) appears to be wrongly ascribed to Prain in Gamble's Flora of Madras (403, 1919) instead of to Baker.

It may be of interest to note that Fischer (*Kew Bull.* 1932: 56) examined Koenig's specimens from India now kept at the Lund Herbarium but did not find any specimen of *Cassia surattensis* or *Cassia glauca*.

A tall shrub or a small tree; young branches adpressedly pubescent, older twigs glabrous; stipules subulate, 1 cm. long; petioles 2 to 3 cm. long, glabrescent; rachis thinly pubescent with 2 or 3, erect, clavate glands, located on the lower part of rachis (one gland in between each pair of leaflets); leaflets 6 to 10 pairs, obovate oblong, obtuse or rounded, finely pinnate-reticulate, 2 to 4.5 cm. long, 1 to 1.5 cm. wide, upper surface glabrous, lower glaucous minutely pubescent; peduncles axillary, 2 to 6 cm. long; inflorescence corymbose; pedicels about 2 cm. long; sepals 7 mm., elliptic; petals 1.5 to 2 cm. long, distinctly unequal; stamens 10, all equal and perfect, lower two on longer filaments; pods 6 to 10 cm. long, 8 to 12 mm. wide, glabrescent, margin raised.

Distribution: India, Burma, Malaya, Java, Australia. Cultivated in many countries.

INDIAN BOTANIC GARDEN,
CALCUTTA,
August 19, 1960.

D. CHATTERJEE

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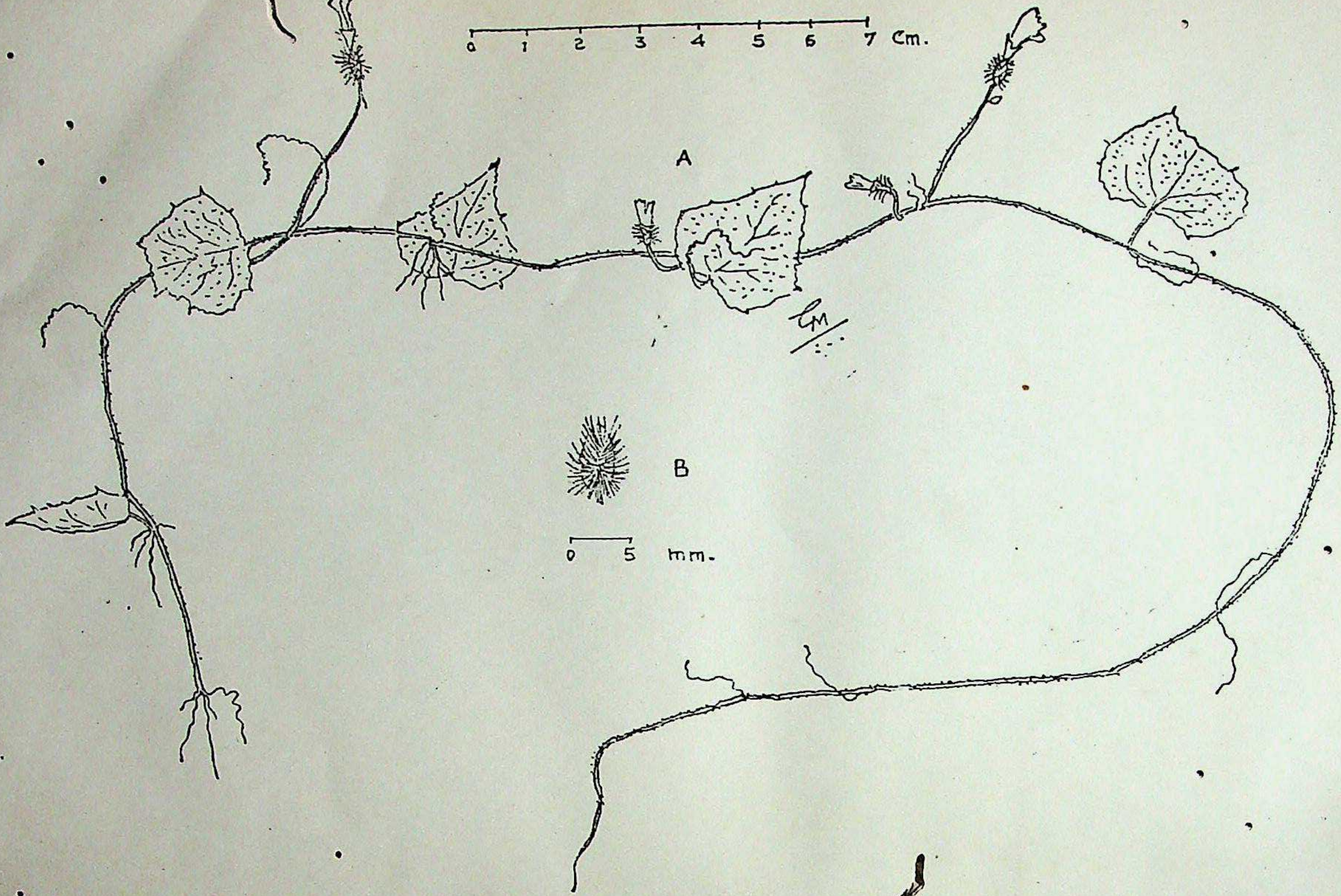
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mm.

Cucumis setosus Cogn.
A. Flowering branch; B. Fruit.

27. *CUCUMIS SETOSUS* COGN.—A NEW RECORD FOR BOMBAY

(*With one plate*)

In our exploration of Pavagadh Hill, 46.6 km. NE. of Baroda, we have come across a cucurbit which is not described in our common floras. Chakravarty (1959) in his recent monograph on the Indian Cucurbitaceae describes this plant. A few notes on the distribution of the same are interesting.

Cucumis setosus Cogn. in DC. Monog. Phan. 3: 491. 1881; Chakravarty, Mon. Ind. Cucur. 106, f. 44, A-D & f. 45, map 51, 1959. —A slender climber, monoecious. Stem furrowed, clothed with minute coarse hairs. Tendrils slender. Leaves 2-2.4×2.1-2.6 cm., membranous, deltoid, feeling roughish to the touch, acute, minutely dentate, 3-lobed, 5-nerved, petiole 6-9 mm. long. Flowers small, solitary, yellowish. Calyx tube campanulate, hairy. Corolla glabrous. Ovary globose, oblong; covered with short soft hairs. Fruit setose (covered with bristles).

Flowering and Fruiting: 26th September 1959.

Records from India: (*a*) Chakravarty lists two specimens for India. 'In Eastern India (*Ritchie* 321 Herb. Edin.); without precise locality, probably peninsular India (Witt, no. 191 A. 5-D,25/10/12 Herb. Cal.).' (*b*) The specimen referred to in the present note was collected by the junior author from Pavagadh, in the forest at an altitude of 461 m. on 26-9-1959, and is preserved in the Herbarium, Department of Botany, M.S. University of Baroda.

Index Kewensis gives India as the home of this plant. Chakravarty, loc. cit., mentions only two sheets so far available. Of these two sheets, the one of Ritchie is from eastern India and that of Witt is *probably* from peninsular India without any further details.

The plant seems to be endemic in S. India; it has not been recorded from Bombay. It is, therefore, a new record.

DEPARTMENT OF BOTANY,
M.S. UNIVERSITY OF BARODA,
BARODA,
July 25, 1960.

A. R. CHAVAN
G. M. OZA

28. PHYLLODY OF THE GYNOECIUM AND ANDROECIUM IN YLANG-YLANG TREE, *CANANGA ODORATA* HOOK.

(*With a plate*)

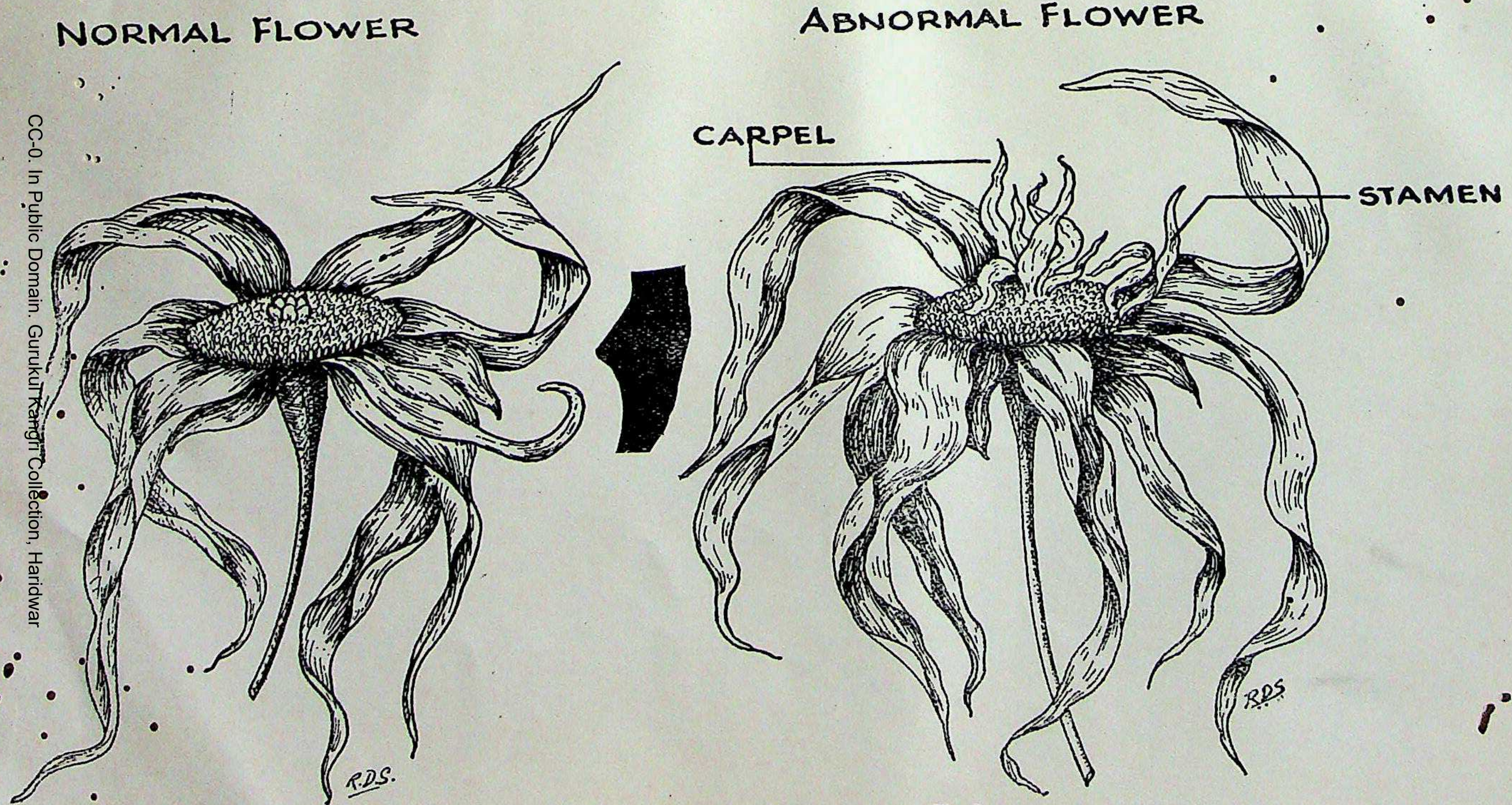
An interesting occurrence of phyllody of the gynoecium and part of the androecium was observed in some flowers of *Cananga odorata* Hook. from the Victoria Gardens, Bombay, in June 1960. Some of the flowers were normal, showing the typical flower of Annonaceae; in some flowers small leaf-like structures were observed in place of the usual free carpels. Both types of flower were collected from the same plant, which appeared to be quite healthy.

Normal as well as abnormal flowers have a calyx consisting of three sepals, which are green, broad, and gamosepalous. The number of petals in the corolla varies in different flowers; smaller flowers have six petals; in larger flowers the number varies from 6 to 12, the more frequent numbers being 7, 8, 9, or 10. The outer petals are bigger, somewhat linear, with an irregularly wavy margin. The petals appear to be folded or twisted, especially in the upper half.

The androecium consists of more than 100 stamens arranged in 5-6 concentric rows on a very slightly elevated, somewhat flat, thalamus. In many flowers it was observed that one or two stamens of the outermost whorl had been transformed into small leaf-like structures. The odd number of petals found in the flowers may be due to one or more of such transformed petaloid stamens being added to the original six segments of the corolla. In such stamens it seems to be the prolonged connective which has been transformed into a leafy structure.

The gynoecium of the normal flower consists of six carpels in which the ovaries and the styles are free, but the stigmas are loosely connected with each other. In abnormal flowers, however, these free carpels have been transformed into leafy structures of varying sizes. Ovules are not developed in these carpels.

Such transformations of the stamens and carpels are common in plants, especially in the Leguminosae. Cooper has reported transformation of carpels and stamens in *Crotalaria striata* DC.; Trivedi & Nigum have reported similar transformation of the stamens in *Bauhinia acuminata* L.; T. C. N. Singh has recorded phyllody in *Trifolium alexandrinum* L., in which some petals, stamens, and gynoecium have been transformed into leaves of various sizes.


NORMAL FLOWER
ABNORMAL FLOWER
CARPEL
STAMEN
R.D.S.
R.D.S.

Phyllody of carpels in *Caranga odorata* Hook.

Recently Mahajan has reported petaloidy of stamens in *Hedychium coronarium* Koenig. Similarly Jayaweera has mentioned petaloid stamens in *Syzygium malacense* Merr. & Perr. From these records it will be noted that phyllody of stamens seems to be more common than phyllody of carpels. The present note is written with the intention of recording phyllody of carpels in *Cananga odorata* Hook., which has so far not been previously mentioned. The fact that this transformation of carpels into leafy structures occurs only in a few flowers in a given plant seems clearly to support the theory that flowers and all their parts are but modified foliage leaves; the facts noted in *Cananga* seem to be but a reversion to ancestral type.

Here we wish to express our gratitude to Rev. H. Santapau, S.J., F.N.I., Director of the Biology Section, St. Xavier's College, Bombay, for critically going through this note and for his suggestions.

BOTANY DEPARTMENT,
INSTITUTE OF SCIENCE,
BOMBAY 1,
August 23, 1960.

(SMT.) K. V. MARATHE
B. S. NAVALKAR

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29. BLACK COLOUR IN FLOWERS: IS THERE SUCH A COLOUR IN NATURE?

In popular literature one often finds references to the black colour of flowers; a correspondent writing in *The Indian Express* of December 2, 1959, mentions that the flowers of the common gram, *Cicer arietinum*, 'grow in four different colours: red, white, yellow, blue or black'.

Sir Robert Robinson (in *Endeavour* **1**: 92, 1942) lists the chief groups of vegetable pigments as (*a*) green chlorophyll and its analogues; (*b*) yellow and orange caritinoids; (*c*) miscellaneous pigments such as are found in fungi; (*d*) yellow anthoxanthins and orange, red, magenta, violet, and blue anthocyanins. Nowhere in the scientific literature is there any mention of black colour for flowers; there may be, and in fact there are in India, a number of plants that turn black on drying; but there is no such thing as a black-coloured flower in the fresh condition.

We have in Bombay several flowers, wild or cultivated, that may have such a deep brown colour as to appear black; such is the case, e.g. in *Iphigenia indica* of our hills, or some of the cultivated Pansies. The flowers are very deep brown when fresh; none of them is truly black.

Among the parasites of the group of *Striga* (fam. Scrophulariaceae) and other parasites, and in e.g. *Ixora nigricans*, the whole plant becomes black when fully dry. Our tea leaves, or the common tobacco leaves, out of which many of the 'stronger' cigars are made, also turn black; but this is due to faulty drying, that is to say, to fermentation in the process of drying. Botany students often find that their green specimens turn more or less deep black, when sufficient care has not been taken during the drying of the specimens.

In a word, there is no black flower as far as my knowledge goes; there may be such deep brown as to appear black at first sight; there may also be real black colour due to faulty dehydration of some specimens; or there may be an over-all black colour in the case of dry parasitic plants. This is as far as black colour goes in plants.

ST. XAVIER'S COLLEGE,
BOMBAY,
December 2, 1959.

H. SANTAPAU, S.J., F.N.I.

30. FOOD FROM GRASS MINUS THE COW

Under the above title, the *Daily Telegraph and Morning Post* of London of May 18, 1959, reports on what has been termed a 'mechanical cow', a machine that extracts proteins from grasses and other green plants. It is well known that proteins are essential for human beings and further that a large part of the population of India suffers from malnutrition, especially from protein deficiency. In other parts of the world sufficient proteins can be obtained from meat, fish, eggs, and milk products; but most of these products are either absent from the diet of the average Indian or at least are supplied in much too small quantities to satisfy the needs of the human body.

Proteins found in grass can to a very small extent be extracted by the cow; experimentally it has been found that only about 5% of the proteins in grass are actually extracted by cows. Such proteins are made available to us in meat and milk. But in the present condition of food shortages, it is almost criminal to allow 95% of the proteins in grass to go waste.

The 'mechanical cow' has been set up at Rothamsted Experimental Station; the machine is able to extract at least 50% of the proteins in grass. The Science Correspondent of the *Daily Telegraph* writes on the working of the machine: 'When I saw it this week it was consuming rye. From a normal elevator this was fed into a chopping machine. The chopped rye then entered a press and the juice was squeezed out of it. This juice, which contains the bulk of the protein and hardly any of the cellulose, is then treated with steam: the object being to precipitate the protein. When the protein is precipitated, or made solid, it only requires a filtering process to retain the protein and let all the unwanted juice pass through. Within a very few minutes the 'cow' has produced solid, cake-like protein from green leaves and, what is more important, has collected at least 50 per cent of the protein in the leaves. Moreover, both the juice-less rye choppings and also the waste juice from the filters are still good feeding stuff for animals.'

This is certainly an interesting development. India can ill afford to waste any fodder; under the best conditions, according to the statement made a few years ago by the Director, Animal Husbandry Dept., Govt. of India, the country has enough fodder for scarcely one half of its cattle, if the latter is to be fed properly. The new method does not reduce the quantity of fodder available for cattle, but makes better use of the same.

c/o LLOYDS BANK LTD.,
39, PICCADILLY,
LONDON W. 1,
December 2, 1959.

R. W. BURTON
Lt.-Col., I.A. (Retd.)

Gleanings

Longevity in Wild Birds

The following records of longevity in birds reproduced from page 214 of *The Ring*, Vol. 22, February 1960, may be of interest :

Numenius arquata—Curlew : Ringed as a pullet on 4-7-1926 in Sweden, recovered on 25-1-58 in Great Britain, age 31 years 6 months 21 days.

Milvus milvus—Kite : Ringed as a pullet on 19-6-30 in Switzerland, recovered on 15-3-1956 in France, age 25 years 8 months 24 days.

Locusts as a Delicacy

'For the first time since we had arrived in the Tassili we saw some flights of locusts. The insects were not very numerous, but they rejoiced the hearts of our Tuareg, who at break of dawn set out to catch the creatures on the trees where they had alighted. It was manna from heaven, for one and all the inhabitants of the Sahara, whether they be Arab, Tuareg or ' Moor ', enjoy a meal of fried locusts.

'Matal and Agaoued, who had gone off to see the donkeys grazing, brought back one morning a sackful of locusts which they at once threw living upon hot cinders. A locust, at least to our French palates, is not really what you call a titbit, but for men who are always hungry and whose usual fare is lizards and small rodents, locusts make a very acceptable meal. When a locust is fried or grilled its legs are pulled off (for these are set with prickles), and as much of the wings as has not been consumed by the fire is removed. The head is wrenched off at the same time and the digestive tube extracted for this is quite uneatable on account of the green matter it contains. The rest of the insect is then munched much in the way that we eat shrimps. Sometimes the Tuareg reduce the grilled locusts to powder and place it in skin sacked (*mezwed*) so that it can be eaten, with the addition of water or milk, when the men are travelling.

'I myself rather like locusts and at times have eaten nothing else for weeks, but I am free to admit that the taste is not to everyone's liking. It seems, however, that the really smart thing to do now in the Ourgla oasis—where the oil-men forgather—is to serve grilled locusts (at five francs apiece !) with the *apéritifs*. Maybe a rather expensive bit of snobbery, but one that certainly does provide plenty of local colour.

'All the members of the team wanted, of course, to sample the locust. Each one of them gave his opinion. Michel Brézillon thought they tasted like cardboard. Vila compared them with nuts. Lajoux said they reminded him of grass. I maintained they had a savour of shrimps, while Guichard made a grimace and spat out the insect after a vain attempt to swallow it. For him, it was for all the world like excrement.'

Henri Lhote: THE SEARCH FOR THE TASSILI FRESCOES: THE STORY OF THE PREHISTORIC ROCK-PAINTINGS OF THE SAHARA. Translated from the French by Alan Houghton Brodrick. (Hutchinson of London, 1959)

A New Method of Insect Control

Over the last few years many attempts at insect control have been made in India by the use of DDT and other chemical poisons. Malaria has been eliminated over large areas but many other insects besides mosquitoes have been destroyed at the same time and the consequent ecological changes may lead to untoward results which were not foreseen.

Interest will therefore be felt, not only in India but all over the world, in a revolutionary method of insect control, which has given successful results in the United States. The screw-worm fly (*Callitroga hominivorax*) is found in large areas of the southern states of the Union. The adults lay eggs in open wounds in large and small mammals and the maggots produce conditions which attract more flies and eggs, finally leading to the death of the infected animal unless treated by man.

The U.S. Department of Agriculture and the Florida Livestock Experimental Board raised millions of screw-worm flies under factory conditions, where they were fed on horse and whale meat and then rendered sexually sterile by gamma rays from a Cobalt-60 source. These flies when sexually mature were released over the insect-infested areas (70,000 sq. miles) in Florida from aeroplanes. The behaviour of both males and females was unchanged but the effect upon the population of screw-worm flies was greater than anticipated. Within a year after the initiation of the programme the insect was eradicated, and 'not a single screw-worm fly has been seen in the southeastern U.S. for almost two years'. This method has many advantages over the usual control technique. It is effective only on the species concerned. The insects do not acquire immunity to sterile matings as they do to insecticides. In addition to this, when poison is used, it becomes less efficient as the population declines and is left in isolated pockets; the few survivors can then again build up the population in geometric progression. The sterile male increases the overall effectiveness of the attack and becomes more effective on a restricted population.

Any problem of this kind requires a large amount of preliminary work as well as co-ordinated working at a later stage, but the results are so effective that this method of insect control is superior to any other method of insect control devised so far.

Our information is derived from an excellent article on the eradication of the screw-worm fly by Edward F. Knipling at pages 54-61 of *Scientific American* for October 1960.

Notes and News

The Thirteenth International Ornithological Congress will be held at Cornell University, Ithaca, New York, U.S.A., from 17 to 21 June 1962. The President is Professor Ernst Mayr.

The International Ornithological Congresses are scientific meetings which have been held at intervals since 1884. Since 1926 a four-year cycle has been maintained except for a twelve-year interruption caused by World War II. The previous Congresses have been held in continental Europe and England.

Persons wishing to receive further announcements, and membership application forms for the Thirteenth International Ornithological Congress should send their names and permanent mailing address to the Secretary-General, Professor C. G. Sibley, Fernow Hall, Cornell University, Ithaca, New York, U.S.A., before 1 February 1962.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1959-60

President

SHRI SRI PRAKASA, *Governor of Bombay*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S.
Rev. Fr. H. Santapau, S.J.
Dr. Sálim Ali

Executive Committee

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Dr. D. V. Bal, M.Sc., Ph.D.
Mr. R. E. Hawkins
Dr. C. V. Kulkarni, M.Sc., Ph.D.
Mr. D. N. Marshall
Mr. D. J. Panday
Mr. D. E. Reuben, I.C.S. (Retd.)
Mrs. Barbara J. Tufty
Mr. Humayun Abdulali (*Hon. Secretary*)
Mr. Surendr Lall (*Hon. Treasurer*)

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Mr. F. C. Badhwar, O.B.E.	*Calcutta*
Mr. G. V. Bedekar, I.C.S.	*Aurangabad*
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Dr. Baini Prasad, D.Sc., F.N.I.	*Dehra Dun*
Dr. M. L. Roonwal, M.Sc., Ph.D., F.N.I., F.Z.S.I.	*Calcutta*
Mr. P. D. Stracey, I.F.S.	*Dehra Dun*
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E.	*Roorkee*

List of members of the Executive and Advisory Committee elected for the year 1960:

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SHRI SRI PRAKASA, *Governor of Bombay*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S.
Rev. Fr. H. Santapau, S.J.

Executive Committee

Dr. D. V. Bal, M.Sc., Ph.D.
Mr. G. V. Bedekar, I.C.S.
R. S. Dharmakumarsinhji
Mr. R. E. Hawkins
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Mr. D. N. Marshall
Mr. K. J. Nanavatty, I.P.
Mr. D. J. Panday
Mr. D. E. Reuben, I.C.S. (Retd.)
Dr. H. Trapido, M.D.
Mr. Humayun Abdulali (*Hon. Secretary*)
Mr. Surendr Lall (*Hon. Treasurer*)

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Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D.	*Mysore*
Mr. E. P. Gee, M.A., C.M.Z.S.	*Shillong*
Dr. Baini Prashad, D.Sc., F.N.I.	*Dehra Dun*
Mr. P. D. Stracey, I.F.S.	*Dehra Dun*
Dr. M. L. Roonwal, M.Sc., Ph.D., F.N.I., F.Z.S.I.	*Calcutta*
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E.	*Roorkee*

HONORARY SECRETARY'S REPORT FOR THE YEAR 1959-60

At the last Annual General Meeting held on 31st August 1959 I presented a supplementary report up to that date. Except for the references to the *Journal* and the revenue account, this report deals with the period of one year since then.

THE SOCIETY'S JOURNAL

Volume 56 of the *Journal*, publication of which was completed in the year under report, contained 34 articles and 84 miscellaneous notes. We have to express concern that it is becoming more and more difficult to obtain material relating to matters of natural history.

GENERAL

The negotiations with the Central Government regarding a block grant for the construction of a building for the Society in the Prince of Wales Museum grounds in Bombay have not yet been finalized. Plans have, however, been prepared. The building when completed will have over 14,000 sq. ft. of floor space including a lecture room (1160 sq. ft.), rooms for reference collections (6615 sq. ft.), and a laboratory and work room (1160 sq. ft.). The plans and estimates have been forwarded to the Ministry of Scientific Research & Cultural Affairs, and it is hoped to finalise negotiations and commence building at an early date.

The funds made available by the Rockefeller Foundation, referred to in the supplementary report last year, have been usefully expended. In addition to a second bird-banding project in Kutch, 18 grants to the extent of about Rs. 5700 were made for various problems, botanical and zoological ; some of the results will be published in our journal in due course.

The first bird migration camp in Kutch referred to in the last report was supplemented by a small grant from the World Health Organization. This made it possible to obtain the advice and assistance of Dr. A. Schifferli, Director of the Swiss Migration Centre at Sempach, who visited India particularly to assist in the field. A second camp was established at Kuar Bet on the borders of the Rann of Kutch for the spring migration. Subsequent to this the World Health Organization have made a grant of $ 8000.00 to continue this work with a view to investigating the relationship between the movements of birds and the spread of virus diseases.

In my last report I referred to the indexing of the books in our library. This work has now been completed, and a grant from the Government of Maharashtra has enabled us to purchase a sufficient number of cabinets to hold all our books. 201 new books have been added to the library during 1959 and the current year up to 31st August. These include 74 purchased, 114 presented, and 13 received for review.

Over the same period about 500 birds and 100 reptiles and amphibians have been added to our collections. They include, among birds, the type of a newly described race, *Dumetia hyperythra navarroi*, several Finn's Bayas (*Ploceus megarhynchus*) whose re-discovery in the wild I referred to in my last report, and a pair of Godwin-Austen's Hornbills [*Ptilolaemus tickelli austeni* (Jerdon)]. The identified reptiles include specimens of the little known species *Barkudia insularis* of Annandale from Waltair, and *Platyurus platyurus* from Nepal, and the amphibians *Rana afghana*, tadpoles of *Megalophrys* sp. from Nepal, *Bufo andersoni* from Kutch, and *B. latastii* from Kashmir, which are all new additions to our collection. Other rarities and interesting specimens will no doubt be discovered when the collections have been more fully worked out.

With the funds made available by the State Government, orders have been placed for steel cabinets to house the birds and mammals in our collection. It is hoped that when these come in and the specimens are suitably transferred to them, the large collections will be more easily accessible and more work will be done thereon.

During the year, Dr. (Miss) Rachel Reuben delivered an interesting talk on 'Insects and Weather' and Mr. Leslie Brown showed a coloured movie film accompanied by a talk on 'Eagles'.

PUBLICATIONS

Unfortunately, we have not been able to make much progress with the new editions of the Animal and Bird books. Work has been held up mainly by financial difficulties and we are negotiating with the Ministry of Scientific Research & Cultural Affairs for a grant in this connection. The text and pictures of both the books are ready and it is hoped that the negotiations will be completed shortly and that it will be possible to have them ready at an early date. Dr. Dillon Ripley's A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN is in the last stages of printing and we hope to publish it in a couple of months.

NATURE EDUCATION

The Nature Education Scheme, financed by the Government of Bombay, is now in its 12th year. Tours of the Natural History Section of the Prince of Wales Museum and special talks on natural history subjects with the aid of exhibited and other specimens, films, and some living animals were continued. Over 4500 children were lectured to.

Nine field-trips were arranged for members of Nature Study Clubs in schools, to different places in the island of Salsette and one to Nirmal Lake near Bassein. The trips are followed by meetings (44 held this year) at schools to help children to collect and preserve specimens and to discuss topics of natural history interest.

Two field-trips for teachers were arranged, one led by Fr. H. Santapau, S.J., to Tansa Lake to study the plants, and the other covering geology by Dr. R. N. Sukheshwala to Elephanta Island.

The fourth booklet OUR MONSOON PLANTS in the series 'Glimpses of Nature' was published. Though these booklets are available in English, Hindi, Marathi, and Gujarati and are very much appreciated by educationists, their sale is comparatively poor, and the stock in hand renders difficult the publication of additional numbers. The fifth, OUR ANIMALS, is almost ready and should be soon available.

A meeting of children to celebrate Wild Life Week was held on 7th October 1959, and some films were shown.

REVENUE ACCOUNT

In the last report I referred to a total membership of 1255 as at the end of 1958 and stated that 274 members had either not paid their subscriptions or could not be traced. Efforts were made to ascertain their whereabouts and, in the absence of any response, we had to remove from the membership rolls the names of 328 members at the end of 1959, including 38 who resigned and 11 who died during the year. With the addition of 88 new members the register as at the end of 1959 showed a total membership of 1058. Efforts are being made to enrol more new members by the distribution of a brochure depicting the history and activities of the Society, which we have been able to produce with the funds made available by the grant received from the Rockefeller Foundation.

During the year under review the income of the Society rose to Rs. 57,657.40 as against Rs. 47,374.00 in the previous year. This was mainly due to a grant of Rs. 8000.00 having been received from the Government of India. During the year the Society ran out of stock of two of its most popular publications and this resulted in a drop in income from this source by approximately Rs. 2010.72 which we were largely able to make up from other sources of revenue.

The operations of the Society during 1959 showed a deficit of Rs. 2221.00 as against Rs. 11,448.00 in 1958. A promised recovery of Rs. 3155.00 from the Prince of Wales Museum in respect of half the salary of the Acting Curator, referred to in the last report, has now been made and has been adjusted towards last year's deficit of Rs. 11,448.00 thus reducing the deficit for that year to Rs. 8293.00. Had it been possible to secure the Government of India grant of Rs. 8000.00 in respect of 1958, the deficit would have been reduced to Rs. 293.00 only and attempts are still being made to secure this grant.

Expenses during the year amounted to Rs. 59,878.89, an increase of Rs. 1056.75 over the previous year. The increase is chiefly attributable to the cost of shifting the reference collection from the Museum to our premises and travelling expenses paid for interviewing candidates for the post of Curator, both non-recurring items of expenditure.

Of course, the appointment of a Curator will mean an additional expenditure of approximately Rs. 10,000.00 in 1961 but the Executive Committee is actively considering ways and means of increasing the Society's income to meet this expense.

STAFF

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

ACKNOWLEDGEMENTS

The Committee's thanks are due to Mr. J. L. Bernard who continues to look after the Society's interests in the United Kingdom.

THE BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31 DECEMBER 1959

FUNDS AND LIABILITIES		Rs nP	Rs nP
Trust Fund or Corpus:			
Life Membership Fund:			
Balance as per last Balance Sheet ...		97,340.28	
Add: Amounts received during the year...		150.00	
			97,490.28
Other Earmarked Funds:			
Field Work Fund:			
Balance as per last Balance Sheet	2,909.97		
Less: Spent during the year...	950.00		
		1,959.97	
Expedition Fund ...		1,800.00	
Wild Life Fund ...		715.25	
Mammal Survey Fund:			
Balance as per last Balance Sheet	3,265.73		
Less: Spent during the year ...	194.09		
		3,071.64	
Building Fund ...		30,000.00	
Nature Education Trophy Fund ...		500.00	
Reserve for Wall Snake Charts ...		3,000.00	
Unspent Grant of Government of Bombay:			
Balance as per last Balance Sheet	33,515.43		
Less: Spent up to 31.3.59 ...	16,860.85		
	16,654.58		
Less: Spent for equipment & Furniture after 31.3.59 ...	480.29		
	16,174.29		
Add: Transferred from Income and Expenditure Account	11,656.83	27,831.12	68,877.98
Carried forward ...			1,66,368.26

ASSETS	Good	Doubtful	Rs nP	Rs nP
Immovable Properties				nil
Investments: (At cost) ...				
Rs. 14,000 4% Bombay Port Trust Bonds			10,780.00	
.. 15,000 4% Bombay Improvement Trust Bonds ...			11,400.00	
.. 36,000 3% Funding Loan 1966-68 ...			35,812.62	
.. 25,000 3% Conversion Loan 1946 ...			25,000.00	
.. 2,000 3% First Development Loan 1970-75 ...			1,948.75	
.. 92,000 (Market value Rs. 83,785)			84,941.37	
£ 460 3½% Defence Bonds			6,133.34	
			91,074.71	
Less: Provision for Depreciation ...			3,750.00	
				87,324.71
Furniture and Fixtures:				
Balance as per last Balance Sheet ..			1,441.49	
Less: Sold during the year			350.80	
			1,090.69	
Add: Addition during the year ...			103.15	
			1,193.84	
Less: Depreciation during the year ...			145.68	
				1,048.16
Loans: (Secured)				
Loan Scholarships	nil	nil		
Other Loans (to staff) ..	248.39	nil		248.39
Advances:				
To Trustees			nil	
,, Employees			nil	
,, Contractors			6,859.30	
,, Lawyers			nil	
,, Nature Education Scheme			965.64	
,, Others			121.29	
				7,946.23
Income Outstanding:				
Rent			nil	
Interest (Accrued)			1,349.13	
Other Income:				
Supplies and Services			10,700.72	
Government of Bombay Grant			4,000.00	
Carried forward ...			16,049.85	96,567.49

BALANCE SHEET AS AT 31 DECEMBER 1959—(*continued*)

FUNDS AND LIABILITIES		Rs nP	ASSETS	Rs nP	Rs nP
Brought forward ...		1,66,368.26	Brought forward ...	16,049.85	96,567.49
Unspent Grant from Rockefeller Foundation		31,454.42	Government of India Grant	8,000.00	
Liabilities:			Government of Bombay Special Grant ...	34,000.00	
For Expenses	27,443.53		Rockefeller Foundation Grant	2,845.11	
,, Advances (Subscriptions) ...	1,359.71				60,894.96
,, Sundry Credit Balances ...	4,540.38	33,343.62	*Stock of Books on hand:* (At cost or under) As certified by the Honorary Secretary ...		54,028.17
Income and Expenditure Account			*Cash and Bank Balances:*		
Balance as per last Balance Sheet	26,650.69		(*a*) *In Current Account with:*		
Add: Refund of Mr. V. K. Chari's salary in respect of 1958	3,155.63		National and Grindlays Bank Ltd., Bombay	8,215.92	
	29,806.32		National and Grindlays Bank Ltd., London	8,494.59	
Less: Deficit as per Income and Expenditure Account	2,221.49	27,584.83	Fixed Deposit with the Comptoir National d'Escompte de Paris.	30,000.00	
			(*b*) With the Trustee		
			(*c*) With the Cashier	550.00	
					47,260.51
Total ...		2,58,751.13	Total ...		2,58,751.13

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Properties and Assets of the Trust.

(Sd.) (Fr.) H. SANTAPAU,
Trustee.

As per our report of even date.
(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants

BOMBAY, 10*th May*, 1960.

THE BOMBAY NATURAL HISTORY SOCIETY

SEPARATE ACCOUNTS

1. GOVERNMENT OF BOMBAY SPECIAL GRANT ACCOUNT EXPIRING ON 31.3.1960

Cr.	Rs nP	Dr.	Rs nP
To Rent for 9 months from 1.4.59 to 31.12.59 ...	15,750.00	By Grant for 1959-60	34,000.00
,, Salaries from 1.4.59 to 31.12.59	6,447.61		
,, Miscellaneous expenses from 1.4.59 to 31.12.59 ...	145.56		
,, Balance unspent transferred to Balance Sheet ...	11,656.83		
Total ...	34,000.00	Total ...	34,000.00

2. ROCKEFELLER FOUNDATION GRANT FOR 1959-60

Cr.	Rs nP	Dr.	Rs nP
To Contribution to B. N. H. S. Library for book-binding	3,332.20	By Grant ($10,000)	47,000.00
,, Contribution to B.N.H.S. Library for purchase of new books	1,800.00		
,, Bird Migration study expenses at Kutch ...	8,102.68		
,, Field grants to various members	2,310.70		
,, Balance unspent transferred to Balance Sheet ...	31,454.42		
Total ...	47,000.00	Total ...	47,000.00

3. WORLD HEALTH ORGANISATION GRANT

Cr.	Rs nP	Dr.	Rs nP
To Bird Migration study survey expenses at Kutch ...	4,718.79	By Grant ($1,000)	4,718.79
Total ...	4,718.79	Total ...	4,718.79

4. LIBRARY ACCOUNT

Cr.	Rs nP	Dr.	Rs nP
To Purchase of New Books	2,701.36	By contribution from Rockefeller Foundation Grant Account No. 2	5,132.20
,, Subscription to other Societies	677.81	,, Miscellaneous receipts	700.54
,, Book binding expenses	3,332.20	,, Transferred to Income and Expenditure Account ...	878.63
Total ...	6,711.37	Total ...	6,711.37

5. JOURNAL ACCOUNT

Cr.	Rs nP	Dr.	Rs nP
To Cost of printing Journal	17,209.11	By Grant from the Government of India	8,000.00
		,, Transferred to Income and Expenditure Account	9,209.11
Total ...	17,209.11	Total ...	17,209.11

6. PUBLICATION ACCOUNT

Cr.	Rs nP	Rs nP	Dr.	Rs nP
To opening stock on 1.1.1959 ...	53,411.16		By Sales during the year	35,255.24
,, Additions during the year ...	20,673.00	74,084.16	,, Closing stock on 31.12.1959	54,028.17
,, Royalties to Authors		2,451.61		
,, Transferred to Income and Expenditure Account		12,747.64		
Total ...		89,283.41	Total ...	89,283.41

7. MISCELLANEOUS ACCOUNT

Cr.	Rs nP	Dr.	Rs nP
To Expenses for shifting reference collections from Museum to Society's premises	1,190.97	By Transferred to Income and Expenditure Account ...	1,943.45
,, Travelling expenses for interviewing candidates for Curator's post	552.13		
,, Contributions to Scientific Organisations ...	200.35		
Total ..	1,943.45	Total ...	1,943.45

8. ESTABLISHMENT ACCOUNT

Cr.	Rs nP	Dr.	Rs nP
To Salaries including Dearness Allowance ...	21,774.80	By Transferred to Income and Expenditure Account ...	34,014.96
,, Contribution to Staff Provident Fund ...	1,362.48		
,, Postage	1,549.53		
,, Printing and Stationery	1,178.33		
,, Advertisement	123.97		
,, Editors' travelling allowance	1,050.00		
,, Travelling allowance to Honorary Secretary ...	3,600.00		
,, Telephone call charges	461.42		
,, Bank charges	251.42		
,, Audit Fees	512.85		
,, Fire Insurance	157.32		
,, Depreciation on Furniture	145.68		
,, Field travelling expenses	47.88		
,, General charges	1,799.28		
Total ...	34,014.96	Total ...	34,014.96

INCOME AND EXPENDITURE ACCOUNT

Cr.	Rs nP	Dr.	Rs nP
To Journal Account No. 5	9,209.11	By Publication Account No. 6	12,747.64
,, Library Account No. 4	878.63	,, Grant from the Government of Bombay ...	4,000.00
,, Miscellaneous Account No. 7	1,943.45	,, Membership Fees	21,573.15
,, Establishment Account No. 8	34,014.96	,, Entrance Fees	440.00
		,, Interest on Investments	5,019.86
		,, Commission on taxidermy work	44.01
		,, Deficit transferred to Balance Sheet	2,221.49
Total ...	46,046.15	Total ...	46,046.15

THE BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

RECEIPTS	Rs nP
To Bank Balance on 1.1.1959	1,088.75
,, Government of Bombay Grant for 1958-59 ...	6,100.00
,, Government of Bombay Grant *re* increment in salary	1,080.00
,, Sales of Booklet No. I	332.55
,, Sales of Booklet No. II	379.58
,, Sales of Booklet No. III	525.56
,, Sales of Booklet No. IV	259.95
,, Sales of line drawings	32.36
,, Loan from Bombay Natural History Society ...	965.64
Total ...	10,764.39

PAYMENTS	Rs nP
By Re-payment of loan from Bombay Natural History Society	2,004.11
,, Salary of Nature Education Organiser ...	5,875.00
,, Postages	72.25
,, Cost of Printing Line drawings	25.20
,, Cost of Booklet No. II	70.00
,, General charges	392 23
,, Printing and stationery	114.44
,, Cost of Booklet No. III	1,057.10
,, Cost of Booklet No. IV	1,071.55
,, Cash on hand with the cashier	50.00
,, Bank balance on 31 December, 1959	32.51
Total ...	10,764.39

BOMBAY, *10th May, 1960.*

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE DURBAR (TOWN) HALL, BOMBAY, ON WEDNESDAY, 12TH OCTOBER 1960, AT 6 P.M., WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR

1. The Honorary Secretary's Report for the years 1959-60, having been circulated among members prior to the meeting, was taken as read, and was adopted.

2. The Balance Sheet and Statement of Accounts presented by the Honorary Treasurer were approved.

3. The Chairman referred to the recent death of Dr. S. P. Agharkar who was a member of the Society for many years and served on the Executive Committee from 1954 to the date of his death.

A resolution of condolence, to be conveyed to Mrs. S. P. Agharkar, was adopted with all members standing.

4. Dr. Sálim Ali then delivered a talk illustrated by a film on the Bird Migration Studies which are being carried out with funds made available by the World Health Organisation and in collaboration with the Virus Research Centre, Poona. The talk and the film were greatly appreciated.

5. The meeting terminated with a vote of thanks to Dr. Sálim Ali for his talk, to the Asiatic Society for the loan of the premises, and to the Chairman of the meeting.

पुस्तकालय
8140
पुस्तकालय
गुरुकुल कांगड़ी, हरिद्वार

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पुस्तकालय
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THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater. With many coloured and monochrome plates. 2nd (revised) edition. (*In preparation*)

Birds

Game Birds of India, by E. C. Stuart Baker. Vol. III. Pheasants, 1st Edition. **Rs. 20**
(*Price to Members Rs.* 15)

The Book of Indian Birds, by Sálim Ali. With 64 coloured and many monochrome plates, 6th edition, revised and enlarged. (*In preparation*)

Fishes

Circumventing the Mahseer and Other Sporting Fish in India and Burma, by A. St. J. Macdonald. With coloured and monochrome plates. **Rs. 15**
(*Price to Members Rs.* 12)

Snakes

Identification of Poisonous Snakes. Wall chart in English, Gujarati, and Marathi. Rs. 10
(*Price to Members Rs.* 8)

Miscellaneous

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 2nd edition. Revised by W. T. Stearn. Rs. 20
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Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. Rs. 22
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Butterflies of the Indian Region, by M. A. Wynter-Blyth. With 27 coloured and 45 monochrome plates. Rs. 28
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The terms are the same for members living outside India. Such members should pay their subscriptions by means of orders on their Bankers to pay the amount of the subscription, plus postage—in all Rs. 32.50—to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £2-10-0 should be paid annually to the Society's London bankers—The National & Grindlays Bank Ltd., 26 Bishopsgate Street, London, E.C. 2.

CONTENTS

A VISIT TO THE FLAMINGOS IN THE GREAT RANN OF KUTCH. By Shivrajkumar of Jasdan, R. M. Naik, Ph.D., and K. S. Lavkumar of Jasdan 465

FERNS OF NAINITAL. By D. S. Loyal and S. C. Verma 479

CRITICAL NOTES ON THE ORCHIDACEAE OF BOMBAY STATE. IV. THE GENUS *Dendrobium* Sw. By H. Santapau, S.J., F.N.I., and Z. Kapadia, Ph.D. .. 491

ANALYSIS OF THE PROTEINS OF EGG-WHITE AS AN AID TO THE CLASSIFICATION OF BIRDS. By D. B. Peakall, M.SC., Ph.D., M.B.O.U. 511

THE BIRDS OF NEPAL. Part 2. By Biswamoy Biswas 516

REVISION OF INDIAN SPIDERS OF THE GENUS *Cyrtarachne* (Argiopidae : Arachnida). By B. K. Tikader 547

THYSANOPTERA FROM THE NILGIRI AND KODAIKANAL HILLS (SOUTH INDIA). By T. N. Ananthakrishnan 557

A SYSTEMATIC AND ECOLOGICAL ACCOUNT OF THE CYANOPHYCEAE OF HOSHIARPUR. By P. C. Vasishta 579

THE GENUS *Veronica* LINN. OF EASTERN INDIA. By Narendra Mohan Dutta .. 590

REPORT ON THE STATUS OF THE BROWANTLERED DEER OF MANIPUR (INDIA). By E. P. Gee, M.A., G.M.Z.S. 597

SOME NOTES ON SANCTUARIES AND WILD LIFE IN SOUTH INDIA (1959). By O. H. de St. Croix 618

OBITUARIES : 635

REVIEWS : 643

MISCELLANEOUS NOTES 652

GLEANINGS 701

NOTES AND NEWS 707

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1959-60 708

STATEMENT OF ACCOUNTS OF THE BOMBAY NATURAL HISTORY SOCIETY .. 713

MINUTES OF THE ANNUAL GENERAL MEETING 719

Compiled
1999-2000

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